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A CLASSIFICATION OF THE LARVAE OF THE TENTHREDINOIDEA

WITH FOURTEEN PLATES

BY

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THESIS

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I. INTRODUCTION

That the cardinal principle of modern taxonomy is based on the fundamental facts of evolution and that the essential problem of classification is the phylogenetic relationship of organisms need no argument. In order to ascertain genetic affinities, it is not sufficient to investigate the morphological characters alone, but all other attributes, physiological and biological, must be considered. It is also evident that the immature stages of organisms should receive as thoro consideration as the adult if taxonomy of insects is to attain that degree of comparative perfection obtained in the classification of other organisms.

Systematic entomologists, dealing as they do with animals of such diversity and complexity morphologically and biologically, have from early times recognized, at least to some extent, the taxonomic significance and value of the developmental stages of insects, but the practical difficulties in obtaining necessary materials, accurately determined and adequate in quantity and range, have made progress in this phase of insect taxonomy very tardy. A good start, however, has been made by recent workers as was pointed out by Brues (1919), and their results vindicate both the possibilitity and practicability of such investigations. There is, moreover, an urgent demand for such studies from economic entomologists, who are constantly confronted by the problem of identifying the immature stages of economic species.

The present study is an attempt to deal with the larvae of the Tenthredinoidea from the standpoint of synoptic and, to some extent, genetic classification. The systematic significance of the morphological characters will be discussed in part two; the taxonomic treatment of the families, subfamilies, genera, and species will constitute part three; and, as full a discussion of the phylogenetic relationship of the families as is possible with the data at hand, will form part four. No one appreciates the inadequacy of this study, both in thoroughness and comprehensiveness, more than the author, but it is hoped that he has opened a way for those who will advance our knowledge of this highly interesting group of insects to a more satisfactory condition in the future.

The taxonomic literature dealing with the adults of the Tenthredinoidea is extensive. The historical development of the subject is interesting to students of this group of insects but a detailed account is out of place here. However, a brief statement of the history of the group is desirable.

Linnaeus in the fourth edition of the Systema Naturae (1744) established the order Hymenoptera under the name of Gymnoptera and applied to the order its present designation in the first edition of the Fauna Suecica. The name Piezata was proposed by Fabricius (1775) for the order, but this name never came into general use. Latreille (1796), following Linnaeus, divided the order into two sections, Terebrantia and Aculeata. The first section included two groups, Phytophaga, which comprises the Tenthredinoidea, and the Entomophaga or parasitic Hymenoptera. The Ditrocha and Monotrocha of Hartig (1837) correspond approximately with the two sections of Latreille. Gerstaecker clearly recognized the Tenthredinoidea as a unique compact group and proposed in 1867 to divide the order Hymenoptera into two suborders. He used the name Symphyta for the Tenthredinoidea and Apocrita for the remainder of the order. The term Symphyta thus antedates Konow's (1890) subordinal name Chalastogastra. Various terms have been proposed for this group of Hymenoptera and the following are coextensive with the superfamily name Tenthredinoidea as used in the present paper: Phytophaga, Sessiliventres, Securifera, Serrifera, Symphyta, and Chalastograstra. Rohwer and Cushman (1917) proposed a third suborder of Hymenoptera, Idiogastra, for the family Oryssidae and placed it between the Chalastogastra and Clistogastra of Konow.

Early students of the Tenthredinoidea divided the superfamily into two groups, Phyllophaga for the Tenthredinidae or "Tenthredo" of Linnaeus and Xyllophaga for the Siricidae or "Urocerus" of Geoffroy. With the exception of Stephens (1835) and André (1879), who recognized the additional families Xiphydriidae and Cephidae, respectively, besides the two families mentioned above, the old system was followed for many years. With the progress in studies of the world fauna of this group of insects, modern writers have proposed many elaborate schemes of classification. Konow in 1890 suggested one family and three subfamilies and Dalla Torre (1894) catalogued one family divided into eighteen subfamilies, while Ashmead (1898) proposed fifteen families and twenty-seven subfamilies. Enslin (1911) criticized Konow's three divisions as unnatural and proposed four families, Oryssidae, Siricidae, Cephidae, and Tenthredinidae, thus reverting to a considerable extent to the scheme of the old school as represented by Cameron (1882) and others. The recent and more important systems are those proposed by Konow (1905), MacGillivray (1906), and Rohwer (1911). These systems, when compared, show a great discrepancy in the number and rank of the groups which formerly constituted the family Tenthredinidae, as is indicated graphically in Plate XIV. MacGillivray, whose classification is based on a thoro-going phylogenetic study of the wings, is of the opinion that the large complex of genera obtained in this family are readily separable into a number of

definite groups on structural differences, and that they are best dealt with by considering them simply as subfamilies. In general the systems of Konow and Rohwer are, with the exceptions noted below, more in accordance with each other in their essential features than either one of them is with that of MacGillivray. A comparison of these three schemes brings out various points of interest. As far as the major groups are concerned, (1) all are in agreement in associating Xiphydriidae with Siricidae; (2) Konow and Rohwer agree in placing Siricidae and Siricoidea closer to Lydidae and Megalodontoidea respectively than does MacGillivray, as also in associating Megalodontidae with Pamphiliidae and Xyelidae and Pamphiliidae with Cephidae; (3) Konow and MacGillivray agree in the relation of the Blasticotomidae to Xyelidae and Pamphiliidae; (4) Rohwer differs radically from them in his arrangement of the Blasticotomidea, which he places between the Argidae and Tenthredinidae in his superfamily Tenthredinoidea; and, finally (5), Rohwer (1917) is unique in creating a third suborder of Hymenoptera, Idiogastra, for the Oryssidae. In respect to the arrangement of the subfamilies and tribes of the Tenthredinidae, as restricted by MacGillivray, the striking dissimilarity of these authorities in assigning different rank to more or less related groups is well illustrated in their treatment of the Emphytinae, Selandriinae, and Lycaotinae. According to MacGillivray Konow's tribe Selandriades of his family Tenthredinini corresponds to the three subfamilies just mentioned, while according to Rohwer it embraces not only these subfamilies but also another—Allantinae; that is, Rohwer considers the Emphytinae related to the Tenthredinidae thru the tribe Allantini, which, together with the tribes Taxonini and Eriocampini, constitute his subfamily Allantinae. The Emphytinae and Lycaotinae are also related, according to Rohwer, to the Blennocampinae thru his subfamily Empriinae, which contains, besides Empriini and Lycaotini, the tribe Blennocampini. MacGillivray and Rohwer agree in regard to the Cimbicinae to the extent that they both consider it a compact group. Konow differs radically from these writers by associating his tribe Syzygoniides with the Cimbicides and Abiides. In regard to Konow's Nematides and Lobocerotides, the three systems agree fairly well. The affinities of the Blennocampinae, Fenusinae, and Scolioneurinae are recognized by MacGillivray and Konow. Rohwer and Konow agree, as do all other systematists except MacGillivray, in treating the Diprioninae and Monocteninae as allied groups inseparable into subfamilies. Konow's subfamily Lophyrini, however, is a heterogeneous group and includes such widely separated groups as Acordulecerinae and Diprioninae.

The classification proposed by MacGillivray is based upon a critical investigation of an essential structure, the wing, and is a logical conclusion of the application of the taxonomic principles promulgated by Comstock

(1893). This system of classification is adopted in principle in the present paper, for the writer believes that by judicious discrimination between the palingenetic and the cenogenetic peculiarities, the characters manifested by immature insects may be interpreted as indicating the genetic affinities of the insects under consideration, and that in this sense the immature stages of insects are of systematic importance. A classification based upon such larval characters should agree in essential points with that based upon the adult characters chosen for their phylogenetic value, and therefore it is interesting to see whether MacGillivray's alary system is justified by a study of the larvae. It must be stated here that Dr. MacGillivray does not accept all my conclusions as to the relation of the families based upon a study of the larvae.

The immature stages of the Tenthredinoidea of more common occurrence seem to have attracted the attention of naturalists from an early time. In Moufet's Theatorum Insectorum (1634) the adult saw-flies are referred to the group "Vespa" and what seems to be a Tremex to "Odonata," but no mention of the larvae is made. Goedart (1682) was the first naturalist to make observations on the larvae of a saw-fly. His records, rendered in interesting archaic terms, clearly indicate that he had under observation the larvae of Cimbex or Trichiosoma on Salix, and Arge on Rosa. Madame Merian (1730) pictured saw-fly larvae together with those of the Lepidoptera, as may be seen on her plates 22, 25, and 33. Swammerdamm's (1737) figure 1, table XLIV, refers to galls on the leaves and stems of Salix apparently made by Pontania or Euura. He also figured a larva having fifteen segments with larvapods on abdominal segments 3-8 and 11. Frisch (1766) figured about seven species and recorded observations on their life-history. De Geer, as cited by Bergmann, on the authority of Le Peletier (1823), had seen a larva with twenty-two feet exclusive of the anal larvapods. According to the same authority, Reaumur observed certain larvae with twenty-four feet, indicating a xyelidan condition. Linnaeus (1758) recorded the food-plants of twenty-two species of saw-flies out of the forty species of "Tenthredo" enumerated, and spoke of the larvae in general of "Tenthredonis larvae pleraeque folia plantarum exedunt, polypodae, seu pedibus plus quam XVI communiter instructae." Following Linnaeus many students of the Tenthredinoidea contributed much to a knowledge of the immature stages, altho quite disproportionately to their larger contributions to that of the adults. Among those who have done much towards the progress of our knowledge of the larvae, either as original investigators or as compilers or as both, the following are the more important: André, Brischke, Cameron, Costa, Dahlbom, Dalla Torre, Dufour, Dyar, Fallen, Hartig, Kaltenbach, Kirby, Klug, Konow, Latreille, Leach, Middleton, Newman, Oliver, Panzer, Le Peletier, Snellen von Vollenhoven, Spinola, Westwood, and Zaddach.

Still, our knowledge of the immature stages of the Tenthredinoidea is very meager in comparison to that of the adult. The larvae of only 418 species out of the total of 2701 species listed by Konow in his monograph (1905) were dealt with in his artificial table for the larvae. This was less than sixteen per cent of the described species of the world up to his time, and many larvae included in this sixteen per cent were known to this authority only thru literature. According to Dyar (1895) less than twenty-five per cent of the North American species have been recognized in the larval state. It is no exaggeration to say that the larvae of more than eighty per cent of the Nearctic species are yet to be described.

Our knowledge of the physiology and morphology of the immature stages of the Tenthredinoidea is exceedingly meager. The following list includes most of the important literature: Graber (1890) on the embryology of *Arge berberides;* Doncaster (1907) on the gametogenesis and fertilization in *Nematus ribesi;* Büchner (1918) on the accessory chromosomes in Tenthredo, Allantus, Arge, etc.; Frenzel (1885) on the epithelial regeneration of the alimentary canal of the larva of Cimbex; Holtz (1909) on the histology and physiology of the digestive cells in the larva of Nematus; Poletajew (1885) on the silk-glands of the larvae of Cimbex and Tenthredo; Cholodkovsky (1897) on the blood and reflex bleeding of the larva of Cimbex; and MacGillivray (1913) on the general external anatomy of the larvae.

The biology of the Tenthredinoidea abounds in phenomena of great interest to experimental evolutionists and presents many problems of ecological importance. The list of papers dealing with the life-history and habits, especially of economic species, is fairly extensive. Cameron (1882) has published an excellent summary of general biological and ecological observations. The biology of the Nearctic Tenthredinoidea has been discussed in detail by MacGillivray (1913). Since the biological and ecological studies of the Tenthredinoidea are beyond the scope of the present paper, readers are referred to the last-mentioned publication.

Materials.—Four collections, designated for convenience as the Cornell, Maine, MacGillivray, and Yuasa collections, contain most of the materials used in this study. The writer has examined more than 2500 alcoholic specimens of larvae representing at least 400 species during the course of this study. He has also, during the last few years, at Ithaca, N. Y., and at Urbana, Ill., made observations on the life-history and habits of numerous species in his attempts to breed more than two hundred and fifty species.

The Cornell collection consists of about forty species and belongs to the Cornell University. Most of the specimens were collected by Dr. MacGillivray and Mr. Chester Young in the vicinity of Ithaca, N. Y. They were in rather a poor state of preservation and proved useful only

in checking up materials in other collections and in comparing the descriptions of Young with his own material. This collection is designated by the letter C.

The Maine collection consists of about 200 species, many of which were bred and identified by Dr. MacGillivray. The collection belongs to the Maine Agricultural Experiment Station and all the specimens were in excellent condition. They were collected by Dr. MacGillivray with the assistance of Mr. Earl Shaw during the summer of 1913 in the vicinity of Orono, Maine. This collection together with the collecting and breeding records were placed in the writer's hands, and they proved to be indispensable to the present study. The collection is designated by the letter M.

The MacGillivray collection consists of about thirty-five species collected and identified by Dr. MacGillivray, together with larvae of some unidentified species. The specimens came from Ithaca, N. Y., Orono, Me., Onekama, Mich., Urbana, Ill., and a few other localities. This collection is designated by the letter G.

The Yuasa collection consists of about two hundred and thirty species including 98 bred species. A majority of the specimens were collected by the writer at Ithaca, N. Y., during the summers of 1917 and 1918. Some species were collected at Urbana, Ill., and others came from different parts of the United States and Canada thru the generosity of various entomologists. This collection contains also the cocoons of practically all the bred cocoon-making species and eggs and pupae of a limited number of species. This collection is designated by the letter Y.

Besides the four collections just mentioned, a number of rare specimens were generously loaned to me by several people, as subsequently acknowledged, and were of great value in the preparation of this paper.

Identification.—All bred species in the Maine, MacGillivray and Yuasa collections were identified by Dr. MacGillivray. Some of the specimens in the Cornell collection bore labels, and when the larvae agreed satisfactorily with the published descriptions the identifications were accepted. In only a few cases has identification depended solely on published descriptions of larvae.

Terminology and Nomenclature.—For the description of the external anatomy of the head and mouth-parts of the larvae the terms used in my paper (1920) dealing with the generalized insects have been used. Other terms, some new, are used in part II. Taxonomic names have been adopted from Rohwer (1911) and MacGillivray (1906).

Bibliography.—Works on taxonomic units are omitted altogether. A complete bibliography of the Nearctic Tenthredinoidea was not undertaken owing to space limitations, but the most important literature on the subject is listed, as also that cited in the text.

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II. MORPHOLOGY

The external anatomy of the larvae of the Tenthredinoidea has received but little attention from entomologists. The only important contribution on the subject is MacGillivray's study (1913), which deals with the anatomy and coloration as well as with the biology of the larvae. The writer has made a comparative study of the external anatomy of the larvae of representative Nearctic Tenthredinoidea in order to find characters upon which both analytic and synoptic classifications of the larvae might be based. Since MacGillivray has treated the general aspect of the anatomy, only the more important structures and features will be discussed in the following pages.

The larvae of the Tenthredinoidea (Figs. 1-25) are typically subcylindrical, eruciform, caterpillar-like, slightly flattened on the ventral aspect, and usually taper slightly caudad. In the leaf-miners the body is depressed. The body in its metamerism is well differentiated into a head and a series of thirteen somites which are more or less similar in structure. The segmentation is distinct. The first three segments compose the thorax and are distinguishable on account of their position, form, and, in podous larvae, more readily by the presence of three pairs of thoracic legs. The abdomen consists of the ten remaining visible segments and in polypodous larvae the presence of larvapods gives a characteristic appearance to the uromeres. They are usually subdivided by transverse depressions into annulets.

Head.—The head (Figs. 26-38) is typically subglobose, more or less circular in frontal contour, strongly chitinized, and usually setiferous. The mouth is directed ventrad or slightly ventro-caudad. In the leaf-miners it is directed cephalo-ventrad as in the Fenusinae (Fig. 34) or cephalad as in Phlebatrophia (Fig. 37). The surface of the head may be polished and shiny as in Neodiprion (Fig. 28), or roughened, verrucose, or granulate, and divided into minute irregular areas as in Pteronidea (Fig. 30) and the Cimbicinae (Fig. 29), or, in life, thinly coated with a waxy secretion, as in some Emphytinae. It may be glabrous as in Metallus (Fig. 35) and Phlebatrophia (Fig. 37), or it may be variously setiferous as follows: microscopically and sparsely setiferous as in Tremex; with a few scattering setae as in the Phyllotominae; with minute stiff peg-like setae as in Neodiprion; with numerous promiscuously distributed short setae as in Dolerus

and the Tenthredininae; with long setae as in Pteronidea; or with abundant conspicuous setae as in Monophadnoides and the Cladiinae. The setae tend to be more numerous and longer on the ventral portion of the head. The number and location of the setae on the head vary with the individuals, excepting those on the clypeus and labrum, but their general characteristics, such as relative abundance, manner of distribution, and the kind of setae, are constant within genera and subfamilies. The head may be pale, creamy white, or light brown, but often in life appears as green or greenish white on account of the greenish blood showing thru the cuticle, or it may be blackish or brownish with or without distinct color-markings. The darker color is due to a deposition of colored pigments in the cuticle and is generally permanent in alcoholic specimens. The color and the coloration of the head are generally constant specific characters. There are, however, ontogenetic changes in these respects. The very young stages may be lighter in color and later stages darker, or vice versa as in Cimbex, or all stages except the last instar may be darker and the ultimate stage greenish as in *Pteronidea ribesii*. The color markings may be diffuse in the young and become localized and definite in older stages, as in some species of Dolerus, or they may vary from faint spots to general contiguous markings as in certain species of Strongylogaster. The more common markings are brownish spots on the dorsum of the vertex, on the front, and often caudad of each ocellera. There may be a stripe along the epicranial stem and vertical furrows or dorsad of the ocellarae. When the head is darkly colored the clypeus is usually lighter in color than the other parts of the head.

The head is usually exposed, but there is a tendency in the leaf-miners, wood-borers, and a few others to have the cephalic end of the prothorax produced into a broad fold on the dorsal and lateral aspects. This fold covers the caudal portion of the head as in Tremex, Metallus (Fig. 35), and Caliroa (Fig. 69).

The structures of the head will be discussed under two sections, one dealing with the fixed parts, that is all the immovable parts of the head-capsule, and the other dealing with the movable parts—the antennae and mouth-parts. The fixed parts include the vertex, front, clypeus, labrum, occiput, and postgenae, together with their bounding sutures, ocellarae, and tentoria.

Epicranial Suture.—The inverted Y-shaped median suture of the head is the epicranial suture. The stem (*es*) of the Y originates at the occipital foramen, extends cephalad, dividing the vertex into halves, and bifurcates on the cephalic aspect of the head. Each arm of the bifurcation (*ea*) extends obliquely laterad for a short distance and then bends ventrad to the ventral margin of the head, terminating near a precoila. The epicranial suture is present in all larvae except those of the Xiphydriidae

(Fig. 45), where it is in part indistinct, and in the Siricidae and Oryssidae, where it is obsolete. It is interesting to note that the most highly specialized genus of the Tenthredinidae, Phlebatrophia (Fig. 37), possesses this suture. The relative length of the stem and arms varies in different families and subfamilies. There is a depression near the bend of the arm, as in Lygaeonematus (Fig. 31), which indicates the point of attachment of muscles (*ma*), and should not be confused with a true tentorina (*pn*). Near the ventral end of each epicranial arm there is a thickening of the surface and a pit. This pit is a pretenorina (*pn*) and the thickened piece corresponds to the clypealia (*cl*) of the larva of Corydalis. The pretentorina and clypealia are constant in position and universal in occurrence in the Tenthredinoidea. In the Siricidae the pretentorinae are distinct and sometimes mistaken for ocellarae. In ecdysis the head is split along the epicranial suture nearly to the ventral ends of the arms.

Vertex.—The large area on each side of the epicranial stem is the vertex (*v*). It extends from the dorso-meson of the epicranium to the ventral margin of the head, laterad of the epicranial arm, and cephalad of the occipital suture when this is present, and bears an ocellara (*o*) and antennaria (*ar*). There is on the dorsal part of the vertex on each side a distinct furrow which originates at the occipital foramen and extends cephalad for some distance onto the lateral aspect of the head. This is the vertical furrow (*vf*) and is characteristic of the larvae of the Tenthredinoidea. It is wanting only in the leaf-miners and wood-borers. The nature of this furrows is not known. There is a corresponding carina on the ental surface of the head, and the major muscles of the retractor of the mandible are attached to the ental surface of the vertex dorsad and ventrad of the vertical furrow. The furrows usually converge at the cephalic end, but sometimes are subparallel to each other.

Genae.—The portion of the vertex ventrad of an imaginary line drawn ventrad of each ocellara parallel to the ventral margin of the head is a gena (*g*). The extent of the genae varies, therefore, according to the location of the ocularia. The setae on the genae are sometimes longer than those elsewhere.

Ocularia.—The larvae of the Pamphiliidae, Xyelidae, Tenthredinidae, and Cephidae possess a pair of ocellarae (*e*), one on each side of the head. These organs of sight are remarkably uniform and constant in structure and location. With the exception of Phlebatrophia and the Cephidae, the ocellarae are usually clear, semiglobose or at least distinctly convex, and are located on or near the center of the ocularia (*ou*), which are usually circular and distinctly blackish. The ocularia are located on the vertex dorsad of the antennariae in the Tenthredinidae and caudad of them in the Pamphiliidae and Cephidae. In the Cephidae and Phlebatrophia the ocularia are obsolete and the ocellarae are indicated by pigmented

granules showing thru the cuticle. The ocellarae are obsolete in the highly specialized families, Xiphydriidae and its allies. The life-habits are correlated with the presence and the degree of development of the organs of sight.

Front.—The area bordered by the epicranial arms on the cephalic aspect of the head is the front (*f*). The ventral boundary is indicated by a transverse depression connecting the ventral ends of the epicranial arms. This depression is the fronto-clypeal suture (*fcs*). The depression is usually concave dorsad and often obsolete at each lateral end. The front is usually flattened or only slightly convex and bears scattered setae which vary in number and arrangement in different genera and in arrangement in different individuals. The extent of the front is determined by the length of the epicranial arms. The front is usually subquadrate, often wider than long, but in some cases, as in Caliroa (Fig. 53), it is much longer than wide. In the absence of the epicranial stem the lateral boundaries are indicated by the pretentorinae as in Tremex (Fig. 46). Phlebatrophia (Fig. 37) is unique in possessing a distinct median longitudinal furrow on the dorsal half of the front.

Clypeus.—The area ventrad of the front is the clypeus (*c*). Its ventral boundary is the clypeo-labral suture (*cls*), and the lateral margins are free, oblique, and converge ventrad. The clypeus is usually much wider than long and is divided usually into postclypeus (*po*) and preclypeus (*pe*) by a difference in color and by a transverse row of setae. Sometimes the clypeal suture (*cs*) is distinct, as in some Nematinae (Fig. 31). The clypeal setae vary in number from two to eight or ten but are constant within a genus and often within a subfamily. Four is the most common number.

Labrum.—The small lobe attached to the ventral margin of the clypeus is the labrum (*l*). It is usually transverse and has a median emargination on the ventral margin. This emargination is usually shallow and broad but occasionally very deep, as in Eriocampa and a few other Emphytinae. Dolerus (Fig. 42) is characterized by the distinct asymmetrical median emargination which makes the sinistral half of the labrum much smaller than the dextral. The cephalic margin is nearly smooth and slightly oblique in Tremex (Fig. 46). The labrum is very small in the Xiphydriidae (Fig. 45). From two to several labral setae (*ls*) are borne on each side of the meson, those near the meson being usually smaller than the lateral ones. The number of labral setae are as a rule constant within a genus. A row of setae which may be seen projecting from the ventral surface of the labrum belongs to the epipharynx. The labrum is often divided into halves by a distinct median longitudinal depression, as in Caliroa (Fig. 53), Endelomyia (Fig. 48), and some Tenthredininae. This character is generic in some subfamilies and only specific in others. The labrum in the Cim-

bicinae (Fig. 29) is unique in having a pair of longitudinal depressions on each half which converge ventrad and bound a small median piece.

Postgenae.—The area mesad of the lateral boundary of the vertex on the caudal aspect of the head is the postgena (*pa*). The dorsal boundary is the vertical furrow and the mesal the occipital foramen. The ventral margin is concave and is connected with the labicoria (*lc*). It is usually more or less flat and glabrous. The occipital suture (*os*) is sometimes distinct, as in Pteronidea.

Tormae.—At each end of the clypeo-labral suture there is a chitinized rod which extends onto the ventral surface as far as the epigusta. This is the torma, present in all Tenthredinidae.

Occiput.—The narrow area on the dorsal third of the occipital foramen between the vertical furrows is the occiput. The dorsal boundary is indistinct since the occiput merges with the vertex without any indication of a suture.

Maxillariae.—The very narrow chitinized sclerites which form a subcircular collar around the dorsal and lateral margins of the occipital foramen have been identified as the maxillariae (*my*). They are usually only slightly developed and are continuous with the cervacoria. The identity of these sclerites with the maxillariae of generalized adult insects is uncertain, but they occupy the same position as the maxillariae and consequently are considered as homologous with them. The dorsal third of the maxillariae in the leaf-miners Metallus (Fig. 35), Phlebatrophia (Fig. 37) and Fenusinae (Fig. 34), are strongly chitinized, distinctly concave, trough-like, and produced entad. Along this ental margin a part of the muscles which control the movement of the head are attached.

Occipital Foramen.—The large opening in the caudal aspect of the head thru which the internal organs of the head are connected with those of the body is the occipital foramen (*of*). The ventral margin of the occipital foramen is membranous and connected directly with the labacoria and cervacoria (*cc*).

Precoila.—The strongly chitinized acetabulum located near the ventro-mesal angle of the vertex or the dorso-lateral angle of the clypeus is the precoila (*pr*). The preartis of the mandible (*py*) articulates at this point. The precoila is distinct in all Tenthredinoidea.

Mandibularia.—The small transverse whitish or light-colored area ventrad of the ventral margin of the head on the cephalo-lateral aspect is the mandibularia (*mb*). It is usually only slightly chitinized and merges with the mandacoria without any indication of a suture. The extensacuta (*ec*) of the extensatendon of the mandible is usually distinct. The mandibulariae are sometimes very large, as in the Xyelidae (Fig. 27).

Postcoila.—The cup-shaped acetabulum on the latero-ventral angle of the postgena and caudal angle of the mandibularia is the postcoila

(*ptl*), where the postartis of the mandible articulates. The occipital suture (*os*) when present originates in or near the postcoila. The postcoila is always present.

Paracoila.—There is a slight projection at the mesal end of the caudo-ventral margin of the head where the cardo of the maxilla articulates. This is the paracoila (*pl*). It is not well developed but is present and discernible in nearly all tenthredinid larvae.

Odontoidea.—The lateral cervical sclerite is articulated with the head capsule on the mesal margin of the postgena some distance ventrad of the origin of the vertical furrow. This point of articulation is an odontoidea (*od*) and is rather indistinct in the larvae of this group of insects.

Tentorium.—The tentorium is very simple in tenthredinid larvae. It consists of the metatentoria (*mt*), corpotentorium (*ct*), and pretentoria. The supratentoria are apparently obsolete. The metatentorium is the strongly chitinized conspicuous ental bar extending into the head capsule from the ventro-mesal margin of each postgena. The two metatentoria fuse on the meson and form the bridge, the corpotentorium, which gives support to the caudo-ventral portion of the head. The position of each metatentorina is indicated by a pit- or slit-like depression (*mn*). The location of the pretentorinae (*pn*) has already been indicated. A strong ental arm, much smaller than a metatentorium, extends ventro-mesad from each pretentoria into the head capsule and fuses with the corpotentorium near the middle of the latter. This bar is a pretentorium. In ecdysis the tentorium breaks in the middle of the corpotentorium, freeing the mesal ends of the pretentoria and metatentoria. The tentorium in the Xyelidae and Pamphiliidae is similar to that of the Tenthredinidae in structure and location.

The movable parts of the head include all the appendages, that is, the antennae, mandibles, maxillae, and labium.

Antennae.—The antennae are present in the larvae of all Tenthredinoidea, but their structure, size, position, and number of segments vary in the different families and subfamilies. Each is borne by a distinct antennaria (*ar*) which is located in the ventro-lateral portion of the vertex; in the generalized families they are located cephalad of the ocularia; in the specialized, ventrad of them. The antennariae are usually subcircular or subquadrate. The antacoria (*an*) is usually extensive, distinctly convex, and whitish in color (Figs. 143-153). It is only occasionally narrow and confined to the periphery of the antennaria, as in certain Nematinae (Fig. 154). The antennae of the Pamphiliidae (Fig. 26) are setiform, one-half as long as the head is wide, with seven cylindrical segments. There is a circular sensorium on the ventral aspect of the distal portion of the second, third, and fifth segments (Fig. 39). In the Xyelidae (Fig. 27) the segments are shorter but thicker, and vary in number from six to seven

according to the genus. The antennae of the Tenthredinidae (Figs. 145, 147, 149, 150, 153) apparently represent a specialization from those of the Xyelidae. They are much shorter and vary in number of segments from one to five. The antennae vary in shape and are conical in the Emphytinae and other generalized subfamilies, with five ring-like or limpet-shaped segments, with four more or less irregular, incomplete, often partly fused segments in the Nematinae (Fig. 145), or flattened and fused into a single segment in the Schizocerinae or button-like and one-segmented in the Cimbicinae, Fenusinae, and Metallus (Fig. 147), or subconical or irregular as in some Nematinae and Phlebatrophia (Fig. 150). When the antennae consist of five segments, they are usually cylindro-conical and remarkably uniform in shape. The antennal segments are usually strongly chitinized, more or less ring-like, successively smaller in diameter, and the distal segment is conical or occasionally erect and peg-like as in the Diprioninae. The segments do not always form a complete ring; one side may be reduced to a mere line, or be entirely wanting as in some Nematinae, in which cases the segment is said to be incomplete. Sometimes fusion of all or some of the segments may take place. Certain segments are sometimes setiferous and also bear some sensoria. The number of segments is constant for a subfamily. The relative length and shape of the segments vary, but are constant in species in some cases, and in others constant in genera. The antennae of the Cephidae are small, with four or five segments, while in the Xiphydriidae they are three-segmented and in the Siricidae and Oryssidae single-segmented. It is possible, therefore, to arrange the families of Tenthredinoidea in an ascending series according to the number and size of the segments of the antennae. The tenacity of the antennae is well illustrated in the Oryssidae, which in spite of the extreme modification of other structures still retains one-segmented antennae.

Mouth-parts.—The larvae of the Tenthredinoidea possess well-developed mandibulate mouth-parts. They include the mandibles, maxillae, and labium, and are remarkably uniform and constant in structure in the different families. The modifications take place in the relative size of parts and in the number of segments of the articulated parts.

Mandibles.—The mandibles (*md*) are always present, and are typically thick, strongly chitinized, and sharply dentate, the dextral dissimilar to the sinistral in the number and shape of the dentes, and in having one or two and occasionally more mandibular setae on the lateral aspect. The number and arrangement of the dentes, the number of mandibular setae, and the relative size and shape of the mandibles are constant for certain genera. The mandibles of the Schizocerinae are rather thin and flattened, and in Phlebatrophia very thin and elongated with one triangular blade-

like dentis. In this character the larvae of this genus are more specialized than all other larvae, even including Oryssus.

Maxillae.—The maxillae (*mx*) are always present and typically consist of cardo, stipes, subgalea, palpifer, palpus (*mp*), galea (*gl*), and lacinia (*la*). The cardo is usually more or less chitinized and is divided into a small subcardo and a larger triangular alacardo. The subcardo articulates with the head in the paracoila. On the lateral margin of the alacardo the large stipes is attached. The stipes is usually less chitinized than the cardo, submenbranous, convex on the lateral aspect, and attached to the lateral margin of the alacardo. The cephalic aspect is membranous and is continuous with the maxacoria. The caudal aspect along the mesal margin is strongly chitinized and continuous with the elongate triangular subgalea. The line of fusion is indicated by a distinct oblique chitinized ridge which extends from near the proximal end of the subgalea to the lateral angle of the lacinia. The latero-ventral angle of the stipes is often produced as a small triangular lobe, the stipal angle of Crampton (1921) as in the Tenthredininae. The palpifer is a more or less membranous, mound-like lobe attached to the distal end of the cephalic margin of the stipes and often bears one or more setae. The palpus is borne by the palpifer and typically consists of four more or less conical segments. The relative size and shape of the segments vary and afford good characters for the separation of genera and species. The galea is typically strongly chitinized, digit-like, conical or slightly curved mesad, bluntly pointed, unsegmented, and usually smaller than the palpus. The lacinia is located mesad of the galea and cephalo-ventrad of the subgalea. It is usually subtriangular, slightly flattened, lobe-like, and bears a row of setae on its oblique mesal margin. It is sometimes distinctly flattened, strongly chitinized, with a stiff row of setae, as in the Emphytinae, or rounded and with minute spinous setae as in Diprion, or with a sharp triangular compressed seta in addition to an ordinary row of setae as in the Xyelidae. The galea and lacinia are always present except in Oryssus but are reduced in size in Tremex. It is interesting to note that in the leaf-miners the palpi are reduced but the galea are usually normal in size and larger than the palpi. In Oryssus the maxillae are fleshy lobes with all the component parts obsolete and with a brownish area in which a few sensory papillae are located (Rohwer and Cushman, 1917). The palpi are apparently two-segmented in the Xiphydriidae and Siricidae.

Labium.—The labium (*li*) consists typically of submentum, mentum, stipulae, palpiger, palpi (*lp*), and togaglossa—representing the fused glossae and paraglossae. The submentum (*sm*) and mentum (*m*) is typically membranous, convex, with two or more setae, and very broad in the larvae of most species. In some cases, as in the Diprioninae, part of the mentum is chitinized. In the leaf-miners, such as Fenusa, Metallus,

and Phlebatrophia, the mentum is strongly chitinized and flattened. There is a distinct median longitudinal depression in Metallus. The palpiger is practically wanting. The palpus is typically three-segmented (Fig. 157). The relative size and structure of the segments vary, but are usually constant for a subfamily or a genus. In Tremex and Phlebatrophia the palpi are apparently two-segmented and very minute, while in Oryssus they are obsolete. The stipulae are typically membranous, broad, sometimes bearing two setae, and fused with the mentum without any indication of a suture. The stipulae are flattened and chitinized in Metallus and the Fenusinae. Totaglossa is typically membranous, subglobose or bluntly pointed, fused with the stipulae without any indication of a suture. It is readily identified on account of its median position and characteristic shape and structure. There is a slit-like opening for the duct of the silk-gland, the sericos (*crv*) on the meson near the caudo-ventral aspect of the totaglossa. The shape, size, and location of the sericos vary but it is always present and chitinized. The cephalic or dorsal aspect of the totaglossa is strongly convex, membranous, and sometimes bears a few minute setae and sensoria.

Prepharynx.—The prepharynx, the so-called "hypopharynx" of the larvae of the Tenthredinoidea, is very simple in structure and the boundaries of the parts that can be identified in generalized insects (Yuasa, 1920) are obsolete. The propharynx consists of the epipharynx and epigusta. The epipharynx is membranous, is of the same size and shape as the labrum, and bears an oblique row of a few setae on each side slightly dorsad of the ventral margin. The epigusta is membranous and is supported on each lateral portion by a torma. The ambipharynx is restricted and membranous. The parapharynx consists of the basipharynx and hypopharynx (*hx*). The basipharynx is subglobose or convex, often slightly chitinized on the sides, sometimes having a few minute setae, and usually converges ventrad. The portion ventrad of the constriction is considered as belonging to the hypopharynx, but is usually membranous and continuous with the cephalic surface of the totaglossa without any indication of differentiation. The laciniae fit against the sides of the constricted part of the parapharynx. No striking modification in form of the prepharynx appears in the different families.

Trunk.—The portion of the body caudad of the head is the trunk. It consists of thirteen segments which connect with the head by means of the cervacoria. The first three segments compose the thorax and the remainder the abdomen.

Cervacoria.—The membrane (*cc*) which connects the thorax with the head is rather broad and usually folded under the protruding cephalic end of the prothorax. There is a chitinized sclerite on each side, the cephalic end of which articulates with the head against the odontoidea and the

caudal end with the epimeron and coxa. This is the lateral cervical sclerite (*lcs*), which is always present and usually distinctly colored—brownish or blackish. The cervacoria is continuous with the submentum on the ventral aspect, and is often produced on the meson as a small mound-like setiferous protuberance, as in Strongylogaster.

Thorax.—The prothorax is usually constricted on the cephalic portion, the dorsal aspect is declivous, and the lateral aspect is produced. The dorsum is typically divided into a narrow cephalic portion and a wide caudal one, which in turn may be subdivided into two or more annulets (Fig. 65). The first division is usually setiferous on the lateral aspect, while the second division is setiferous on the dorsal aspect. On the middle of the lateral aspect there is a large spiracle. This is the mesospiracle (*msp*), which has migrated onto the prothorax. There is another setiferous area cephalo-ventrad of the spiracle. The prothoracic leg is attached to the latero-ventral margin of the segment, ventrad of the setiferous subspiracular area, which is usually produced as a lobe and which Crampton (1918) has designated as the surcoxal plate. There is a small, usually strongly chitinized sclerite cephalad of the leg. This is the episternum-epimeron, or the eupleuron of Crampton. The dorsal aspect of the prothorax and often the lateral one may be chitinized and colored, forming shield-like areas as in the Xyelidae and certain leaf-miners. The prosternum is usually membranous, subdivided into two or more annulets, but sometimes it is flattened and strongly chitinized as in Metallus. There is usually a small pit or chitinized rod near the caudal part of the segment on the ventral aspect. This is the profurcellina (*pfn*) and marks the caudal limit of the prosternum. The mesothorax and metathorax are more or less similar in structure, frequently the largest segments in the body, more or less ring-like and often distinctly annulate. The metaspiracles (*tsp*) are located in the metacoria and are usually minute and functionless. The mesothorax and metathorax resemble the prothorax in other details. In the Fenusinae (Fig. 21) and Metallus (Fig. 22) the dorsum of the mesothorax and metathorax is provided with an ovoid, fleshy, sucker-like, low protuberance (*scp*) on each side of the meson. Its function is not known. Dimorphopteryx is characterized by the presence of a pair of prominent dorsal protuberances on the prothorax and a median protuberance on the mesothorax.

Thoracic Legs.—The larvae of the Tenthredinoidea, with the exception of the Oryssidae, possess three pairs of thoracic legs. They are the most persistent of all the thoracic and abdominal appendages and as a rule are very similar in structure, both facts indicating a common origin. A typical leg consists of five more or less well-chitinized segments: coxa, trochanter, femur, tibia, and a distal segment representing the fused tarsus and tarsal claw.

The coxa (*cx*) is usually the largest of all the segments, subconical, and articulated to the ventro-lateral margin of the segment. The cephalo-dorsal angle is strongly chitinized and articulates against the chitinized end of the episternum-epimeron. There is a distinct oblique depression extending from this angle to the middle of the dorso-distal margin of the coxa. The distal ends of the coxae are usually chitinized and form ring-like thickenings. The ventral half of the coxa is more or less membranous. The trochanter (*tr*) is usually small, longer on the ventral than on the dorsal aspect. The femur (*fm*) is usually cylindrical and is often dilated at the distal end. Its ventro-distal portion is usually membranous and is sometimes produced, forming a pointed projection, the femoral process (*fp*), as in Dolerinae (Fig. 135) and in related subfamilies. The tibia (*t*) is subcylindrical, narrower in diameter at the distal than at the proximal end, and either longer or shorter, than the femur or subequal to it. The distal segment is typically very short and claw-like. The apparent claw (*cw*) represents a fusion of the tarsus and tarsal claw, and is usually sharp and distinctly curved. The segments are usually setiferous and more or less membranous on the ventral aspect and at the joints.

The general plan of structure of the legs is the same in a majority of the larvae, but there are variations in the shape, size, arrangement of setae, and in the number of apparent segments within the families and subfamilies. The variations usually consist in the suppression of the trochanter as in Phlebatrophia (Fig. 136) and the Fenusinae (Fig. 140), or in the modification of the distal segment as in the Pamphiliidae (Fig. 130) and Hylotominae, or in the reduction of the entire structure to a fleshy, subconical, indistinctly segmented clawless protuberance as in Phlebatrophia and certain highly specialized families. The absolute homology of the segments in a modified leg can not be established, but when the number of the segments is less than five it is probable that the trochanter is the first one to disappear.

The Pamphiliidae are distinct from all other tenthredinoid larvae in having setaceous legs with all segments cylindrical except the distal ones. The distal segment is very slender, non-setiferous, straight, and sharply pointed without indication of a claw. The Xyelidae (Fig. 131) possess legs which are small but typical in structure and number of segments. It is quite possible to derive the normal tenthredinid legs from those of the Xyelidae. In the subfamilies of the Tenthredinidae, a series of modifications of the legs is found, altho the majority of the subfamilies and genera are provided with typical five-segmented, well-developed claw-bearing legs. The Phyllotominae (Figs. 141, 142) are characterized by very short, stubby, chitinized legs which consist of four segments, including the large strongly curved claw. Phlebatrophia (Fig. 136) is unique among the Tenthredinidae in having fleshy, rudimentary clawless legs. The Fenusi-

nae (Fig. 140) also possess small four-segmented legs but, unlike the Phyllotominae, have simple and ring-like segments and claws normal in form. The Hylotominae differ from the other subfamilies in possessing apparently six-segmented legs. Their distal portion consists of a distinctly separated tarsus and claw and bears an empodium-like fleshy lobe on the caudal portion of the claw. The minimum number of segments is found in the legs of the Schizocerinae (Fig. 139), where the mesothoracic and metathoracic legs consist of only three simple cylindrical segments, while the prothoracic legs are composed of four. There is a well-developed fleshy subglobose lobe caudad of the claw. It is interesting to note that the gall-makers, for example, Pontania have essentially the same type of legs as the leaf-feeding Nematinae (Fig. 133), while the leaf-mining larvae of the Fenusinae, Schizocerinae, and others, have modified legs. The highly specialized families, Cephidae, Xiphydriidae, and Siricidae, possess fleshy, indistinctly segmented rudimentary legs which are never provided with claws. The most specialized family, Oryssidae, is entirely apodous. The legs present, therefore, very good characters for differentiating the families and the subfamilies of the Tenthredinoidea. The phylogenetic significance of the thoracic legs is quite evident.

Abdomen.—The segments composing the abdomen, with the exception of the two caudal segments, are more or less similar in structure, ring-like, and usually subdivided into four to seven annulets. Segments 2-7 or 2-8 and 10 usually bear a pair of larvapods, the so-called "prolegs," on the ventral aspect. The first and ninth abdominal segments never possess larvapods except in the Xyelidae. The third abdominal segment is more typical than the other segments and least modified, and for this reason has been used as a type for description. In a typical larva this segment is subdivided into a number of annulets on the dorsum and latus dorsad of the spiracular line. The latus ventrad of the spiracular line is typically lobe-like, setiferous, and distinguishable as two areas, the subspiracular area (*ssl*) or the surpedal area (*sdl*) according to the location. When these areas are distinctly lobe-like they are designated as subspiracular lobe and surpedal lobe. The latter corresponds to the thoracic surcoxal plate of Crampton. The subspiracular and surpedol lobes sometimes fuse and extend the full length of the segment as an oblique fold, as in wood-boring larvae and the Hylotominae. In the latter this lobe is conspicuously produced laterad, making the segment distinctly flattened. The subspiracular and surpedal lobes, when fused, are known as the sublateral lobe (*sll*). The larvapods are located on the ventral aspect some distance from the meson. The sternum is divided into two or more annulets, the annulation being usually distinct but its exact limits difficult to determine on account of the presence of the larvapods. The intersegmental coria (*cor*) is distinctly indicated on the venter (Fig. 81). The segmentation

is distinct but the limits of the somites are not so readily determined. The cephalic limit of a segment is usually indicated by the distinct depression on the dorsal and lateral aspects and by the short ventro-lateral depressions which terminates at the cephalic end of the subspiracular lobe. Thus the cephalic limit of a segment is not a straight line, but curves caudo-ventrad and then slightly cephalo-ventrad of the subspiracular lobe. The typical annulation and arrangement of setae, tubercles, and glandubae on the typical abdominal segment are indicated elsewhere (Figs. 73-79). The ninth abdominal segment is readily distinguishable because of its location and shape, and by the absence of spiracles and larvapods. It is typically smaller than the preceding segments, tapers more or less caudad, and usually has one less annulet on the dorsum than have the preceding segments. Its caudal limit is usually distinctly indicated by a deep depression. The tenth, or the apparent ultimate, segment is modified and differs from the other abdominal segments because of the presence of the anus, anal larvapods, and other structures peculiar to this segment (Figs. 89-103).

Tenth Urotergum.—The tergum of the tenth abdominal segment is usually convex and often setiferous. It sometimes bears numerous spinous processes, as in the Blennocampinae and Dimorphopteryx, or paired suranal protuberances as in certain genera of Nematinae, or a median suranal process (*srp*), as in the Cephidae and its allies. In these highly specialized families the tenth abdominal segment is produced cephalad and fits into the deep semicircular emargination of the ninth segment. The tergum possesses a distinct, deep, median longitudinal depression extending from the cephalic end of the tergum to the proximal end of the median suranal process. In the Xyelidae the tergum is produced distinctly hunch-like on the meson of the cephalic third caudad of the deep, broad transverse depression. The tergum is produced caudad in certain species of Pachynematus and forms a distinct caudal projection. In this genus the glandubae are very conspicuous. The size, convexity, number, and arrangement of the spinous protuberances, caudal processes, and setae are useful characters in recognizing different subfamilies and genera.

Suranal Lobe.—The membranous lobe (*srl*) of the Tenthredinidae, which forms the dorsal wall of the anal slit may represent the rudiment of the dorsal half of the ultimate segment, the so-called "telson." It bears numerous setae of varying size and number and is usually fused with the tergum of the tenth segment. In the larvae of the Xiphydriidae and its allies, which possess a median suranal process, the suranal lobe is distinct, more or less chitinized in part, usually separated from the tenth tergum by a ridge or by an oblique suture which extends from the chitinized depression dorsad of the suranal process to the lateral end of the anal slit (*au*). The area cephalad of this oblique suture is the pleuron of the tenth segment.

Subanal Lobe.—The membranous lobe (*sbl*) which forms the ventral wall of the anal slit may represent the rudiment of the ventral half of the ultimate segment or "telson." It is never distinctly chitinized, always indistinguishably fused with the tenth abdominal sternum, usually setiferous, and is rather restricted in extent. In the Tenthredinidae the subanal lobe is strongly convex and extends to the anal larvapods, the postpedes of Crampton. If the subanal lobe represents a part of the telson, and if the subanal appendages (*sba*) of the Pamphiliidae and Cephidae are the appendages of the ultimate segment, then the subanal lobe possesses a pair of genuine appendages. In the larvae of the Xyelidae there occur sometimes distinct subglobose setiferous swellings dorso-caudad of the anal larvapods. Their homology and function are unknown.

Tenth Urosternum.—The sternum of the tenth abdominal segment is restricted in extent, more or less convex, and often glabrous. In the Xyelidae and Tenthredinidae the anal larvapods occupy the greater part of the caudal portion, which is thereby produced subconically ventrad. This sternum is usually glabrous and more or less flattened in apodous larvae. There are no annulations observable on this sternum.

Suranal Process.—In boring larvae, the ultimate segment is provided with a strongly chitinized mesal suranal process (*srp*) on the suranal lobe. This process, which has been variously designated by different writers, is characteristic of the families Cephidae (Figs. 108, 109, 112, 114, 115) Xiphydriidae (Figs. 107, 110), and Siricidae (Figs. 113, 120, 122). The size, shape, number, and arrangement of the dentiform tubercles and setae vary in different families but they are constant within species and often also within genera. It is undoubtedly an adaptive structure developed in connection with the boring habit of the larvae. It is interesting to note that in some of the gall-making larvae of Pontania and leaf-stem boring larvae of Caulocampus, the tergum of the ultimate segment is produced on the caudo-meson and forms a distinct protuberance provided with chitinized points on its caudal end. The larvae of the Pamphiliidae also possess a minute hook-like process on the caudo-meson of the ultimate tergum. The genetic connection of this hook-like tubercle and the distinct suranal process of highly specialized families is doubtful, but it is not difficult to surmise a common origin for the suranal process of the Cephidae, Xiphydriidae, and Siricidae. The suranal process corresponds to the postcornu of Crampton.

Caudal Protuberances.—In certain genera of the Nematinae and in a few other genera of the Tenthredinidae, the tergum of the ultimate segment is provided with two or more protuberances which vary in size, shape, number, and position in different genera. A typical condition in nematid larvae is found in Pteronidea (Figs. 126, 127), which possess a pair of conical, pointed, well-chintinized processes (*srp*), one on each side,

on the caudal margin of the tergum dorsad of the membranous suranal lobe. These processes are always two in number and more or less constant in position in nematid larvae, but vary in size and shape altho constant within species. They are conical, subconical, sharply or bluntly pointed, truncate, or distinctly swollen at the distal end as in *Pteronidea trilineata*. The tenth abdominal tergum of the spinous larvae of the Blennocampinae is provided with several symmetrically arranged conspicuous spinous processes on the caudal portion and in part along the caudal margin. The larva of Dimorphopteryx is unique among the Emphytinae in the possession of four very distinct, sharply pointed spinous protuberances along the caudal margin of the ultimate segment dorsad of the suranal lobe. In certain of the gall-making species of Pontania the caudal end of the tenth abdominal tergum is produced caudad and forms a median prominence which usually has two minute strongly chitinized points close together on the meson. A similar protuberance is found in the larvae of *Caulocampus acericaulis*. In the Siricidae a pair of minute sharply pointed solid chitinized spines occurs on the tergum of the ultimate segment, one on each side of the median longitudinal depression (Fig. 113).

These protuberances have been variously designated. Crampton (1919) considers the paired protuberances and spines to be homologous with the cerci of Orthoptera and Ephemeridae. If they represent rudimentary cerci they must belong to the eleventh abdominal segment, the telson of embryologists, since the true appendages of the tenth segment are transformed into the anal larvapods. But this homology is open to question because these protuberances are mere projections of the surface and not at all appendages in a morphological sense, and, furthermore, because in other larvae the number and position of the protuberances vary considerably. No one would suggest that the caudal tubercles and spinous processes of Dimorphopteryx, Blennocampa, Hypergyricus, Caulocampus, and others are homologous with the cerci of generalized insects; yet, there is no reason to assume that the caudal tubercles of these larvae are different in origin, structure, and function—whatever that may be—from the suranal paired processes of the nematid larvae. These protuberances may or may not be at all related genetically to the suranal median process of the Cephidae and its allies. At any rate our present knowledge does not permit any definite conclusion regarding the true nature or homology of these structures. The interpretation advanced by Middleton (1921) seems more reasonable. He named these protuberances pseudocerci.

Subanal Appendages.—The larvae of the Pamphiliidae (Figs. 91, 95) and Cephidae (Figs. 108, 109, 111, 116, 117, 118, 119) possess a pair of subanal appendages on the ultimate segment, one on each side ventrad of the lateral ends of the anal slit. These appendages are long, setaceous, and three-segmented in the Pamphiliidae, but are rudimentary, papilliform,

and only indistinctly segmented in the Cephidae. When the appendages are long and setiform, the relative length and color of the segments differ in different species. In the Cephidae the appendages may or may not be provided with accompanying setae near the proximal end, and these setae may or may not form a continuous group with the setae on the sternum.

That these structures are true appendages of the segment is indicated by the segmentation and by the fact that they are invariably articulated at the proximal end against the surface, not being mere protuberances like the caudal processes of the tergum. Some embryologists consider these appendages to be homologous with the cerci of generalized insects and the anal "prolegs" of lepidopterous larvae, and, therefore believe them to be true appendages of the eleventh abdominal segment. It is obvious that they can not be homologous with the anal larvapods of other tenthredinoid larvae. Crampton (1919) designated them as arthrostyli on the ground that they are apparently homologous with the styli of the Ephemeridae and other insects. The opinions of entomologists differ, for example Middleton (1921) homologizes the subanal appendages with the postpedes of Crampton. The homology and function of these appendages need further investigation. However, it is significant that long distinctly segmented appendages should occur in the Pamphiliidae and rudimentary ones in the Cephidae.

Larvapods.—The embryological data seem on the whole to support the view expressed by Korschelt and Heider (1899), who say that "the abdominal appendages of the caterpillars of the Lepidoptera and Hymenoptera are to be regarded as true limbs," and that "limb-rudiments first form on all or most of the abdominal segments, but they very soon disappear on those segments which in the larvae have no limbs, while on the other segments they are transformed into the functional prolegs." Graber (1890) has shown that the so-called anal prolegs of Hylotoma are the appendages belonging to the tenth or true penultimate abdominal segment. They are, therefore, not homologous with the anal "prolegs" of lepidopterous larvae, which are, according to Graber (1890), the appendages of the ultimate segment.

The maximum number of larvapods (*plg*) occurs in the Xyelidae, where each of the abdominal segments is provided with a pair. The first and ninth pairs may be smaller than the others, as in Odontophyes, but they are always discernible. The number of larvapods present in the Tenthredinidae varies from six to eight pairs. They are usually present on abdominal segments 2-7 and 10 or 2-8 and 10, rarely on 2-6 and 10. In the Fenusinae (Fig. 105) and Caulocampus the tenth pair is obsolete, and in Metallus (Fig. 103) they are fused together forming a median protuberance. Larvapods are entirely wanting in the other families of the Tenthredinoidea.

A typical larvapod is a fleshy subconical protuberance narrowed toward the distal end, and is usually subdivided into a larger but shorter proximal portion and a smaller but longer distal portion. Sometimes the distal end is dilated and turned mesad, as in Neodiprion (Fig. 82), or the cephaloventral angle is pointed, as in Tenthredo. The larvapods are well developed in most of the free-living larvae but in the leaf-miners and fruit-borers they are reduced and smaller. They are very small in the Hylotominae and rudimentary in the Fenusinae (Fig. 86) and Schizocerinae, while they are obsolete in Phlebatrophia. The degree of development of the larvapods is closely correlated with the habits of the larva. The larvapods are usually located on the middle of each lateral half of the sternum but occasionally are very close together near the meson, as in Neodiprion. The number of pairs of larvapods present is a convenient character for differentiating the subfamilies of the Tenthredinidae. The larvapods often bear a few setae on the cephalic and lateral aspects. The setae, when present, are confined to the mesal aspect. Lack of setae on the larvapods is often a generic character and the number and arrangement of the setae is typical of the species.

Crampton (1919), with good reasons, proposed to substitute the term uropods for the long-used but misleading term prolegs. The term uropoda has been employed by students of the Crustacea in designating the abdominal appendages, especially one of the posterior pairs of pleopods, and according to Smith's glossary of Entomology the term refers to "any of the abdominal feet of Arthropoda." These facts indicate the necessity of a distinctive term, and the new term larvapods following the suggestion of Dr. MacGillivray, is used until a happier term is created for these true abdominal appendages of insect larvae.

Metamerism.—Graber (1890) has shown that the number of somites which compose the body of the larvae of Hylotoma is fourteen exclusive of the head. The first three somites belong to the thorax and the remaining eleven to the abdomen. The ultimate segment, or the telson of the embryologists, is difficult to discern in larvae. It is probably represented by the suranal and subanal lobes of the larvae, but the boundary between this segment and the tenth somite is so obliterated, and the ultimate segment, which is originally much smaller than the preceding somites, is in the larval stage so much more reduced, that it is permissible and also convenient to speak of the abdomen as being composed of ten segments. For this reason the tenth abdominal somite, which bears the so-called anal prolegs, is designated as the ultimate segment in this paper. It is to be noted that Nelson (1915:111) considers that there are eleven segments and a telson in the abdomen of the embryos of Hymenoptera. In all the larvae of the Tenthredinoidea examined, it is always possible to count ten abdominal segments. The body is usually distinctly segmented.

The exact limit of the somite in a larva is not easy to determine. Entomologists seem to have paid little or no attention to this point. Castle (1900) has made an excellent study of the metamerism of the Hirudinea, but his conclusions are not directly applicable to the case of insect larvae tho they are pregnant with important suggestions. He found that the natural and true limits of a somite coincide with the limits of the neuromere, and that both reduction and increase in the number of rings, which correspond to the annulets in the saw-fly larvae, take place at the ends of the segment. The classical work of Lyonet (1762) and the recent study of Forbes (1914) on the musculature of lepidopterous larvae, as also a study of Boving (1914) indicate that the musculature affords a reliable criterion for determining the limits of a somite. From a careful examination of the musculature of various types of tenthredinoid larvae (Fig. 129), the author has come to the conclusion that in these larvae the natural and accurate determination of the extent of the somites composing the body is best based upon the musculature. A detailed discussion of this subject is out of place here. It is sufficient to say that a majority of the longitudinal muscles, including the dorsal, lateral, and ventral retractor muscles, originate on the cuticular fold, or coria, which, on the exterior, is usually indicated by a deep depression (*is*). Only a few muscles of importance cross this fold, nearly all the muscles being attached either to the cephalic or caudal part of the coria. This cuticular fold, therefore, is considered as the cephalic limit of the somite, and the annulets into which the somite is subdivided are numbered consecutively, commencing at its cephalic end. To assume, *a priori*, the spiracular annulet, or the annulet which bears the spiracle, to be the first annulet is arbitrary and inaccurate inasmuch as this annulet, according to the criterion of musculature, corresponds to any one of the first three annulets of the somite. The position of the spiracular annulet is constant and definite within a genus or subfamily as long as the number of annulets of the somite is constant. Some of the annulets are usually setiferous and often bear in addition transverse rows of glandubae. The position of such setiferous annulets is constant within the genus or subfamily when the annulation is constant. The number of annulets on the ninth abdominal segment is always smaller than that on the preceding segments. Since the setiferous annulets have a definite order, it is possible to determine which annulets are obsolete on the penultimate segment. The first annulet to disappear is a caudal one, and ordinarily it is only the caudal annulet that is missing. The number of annulets of the sternum is less than that of the tergum. The length of the annulets varies but their relative size is constant within a species. The primitive number of annulets of the abdominal segments is unknown. If the annulation of the generalized Tenthredinoidea is assumed to be representative of the primitive condition, then four is the primitive num-

ber of annulets. In the specialized Tenthredinoidea the number varies from one to seven, but five to seven is of the most common occurrence. The number becomes smaller in the highly specialized families, being reduced to a single annulet in the Siricidae and Orysidae.

Spiracles.—The spiracles (*spi*) are present on the prothorax and the first eight abdominal segments in all Tenthredinoidea. The pair on the prothorax are always the largest. The abdominal spiracles are usually uniform in size and shape except the last pair, which are often larger than the others. The spiracles are definite in location in regard to the annulets and are always situated on some one of the first three annulets of the segments. The spiracular line is usually located slightly ventrad of the middle of the lateral aspect of the body, but sometimes it migrates ventrad to the latero-ventral line as in Caliroa. The spiracles (Fig. 155) are usually very simple in structure, vertical in position, never circular in outline but narrowly ovate, rounded or pointed at both ends. The peritreme is narrow but strongly chitinized and brownish or blackish. The labiae are narrow and the spiracular opening is usually closed and appears like a dark line. The peritreme is sometimes distinctly thickened as in the Hylotominae. There is often a semicircular or irregular chitinized colored area on each side of the spiracles, as in certain nematid genera. These areas vary in size and shape but are constant within species, and their presence is usually constant within genera and often within a subfamily. When these areas are present, the spiracles are said to be winged.

The true prothoracic spiracles are considered as wanting in adult and larval insects. The spiracles found on the prothorax of Tenthredinoid larvae are the mesothoracic spiracles (*msp*) which have migrated from the mesocoria onto the prothorax. The metathoracic pair (*tsp*) is usually functionless, very small, and located in the metacoria, or obsolete. In the Cephidae and Siricidae, however, the metaspiracles are distinct, functional, and as large as the abdominal spiracles. It is difficult to explain the rudimentary condition of this pair in the Xiphydriidae, since other characters indicate that they have a common origin with the Cephidae and Siricidae. It is possible, however, in the course of evolution, to have one structure of the body modified faster than another structure.

Setae.—The surface of the body is usually provided with some setae, particularly on the head, thoracic legs, and the ultimate segment of the abdomen on the suranal and subanal lobes. The number, size, arrangement, and structure of the setae vary in different taxonomic units, according to their location; and to some extent according to the stage of larval growth. There is a tendency toward the loss of setae in the ultimate stage or the last instar, as is Pteronidea, or to have fewer and smaller setae in the leaf-mining and wood-boring larvae, as in the Fenusinae, Cephidae, and others. There seem to be no definite setal patters, as in lepidopterous

larvae, but when certain annulets of the segments possess setae their presence on these annulets in successive segments is constant if not in precisely the same number and order. There is a tendency to have more and longer setae on the lower half of the head than on the upper half. The number and arrangement of the setae are variable on the vertex and front but are fairly constant on the clypeus, labrum, and mandibles.

A spinal formula is an abbreviated expression of the arrangement of the tubercles or spines on the various parts of the body. The figures of the formula indicate the number of branches of a spine and are arranged in order, beginning with the mesal spine in the case of those on an annulet and with the cephalic spine in the case of the subspiracular areas. The spinal formula of the prothoracic segment represents the arrangement of the spines on the large or second annulet, on the first or smaller lateral annulet, on the subspiracular area, and on the postsubspiracular area respectively. The spinal formula of the third abdominal segment indicates the arrangement of the spines on the first tubercle-bearing (usually 2d) annulet, on the next small annulet if this is present, on the third tubercle-bearing (usually 4th) annulet, on the subspiracular area, and on the post-subspiracular or surpedal area, respectively.

The number of branches of the spines sometimes varies and the arrangement of the spines also may show minor variations. The spinal formulae represent the most typical arrangement.

Glands and Glandubae.—There are many types of glands opening to the exterior found on the various parts of the body of the larvae of the Tenthredinoidea. The larvae of the Nematinae and Cladiinae are provided with a series of ventral glands on the ventro-meson of abdominal segments 1-7. Sometimes a pair of eversible glands is found in the cervical region, as in *Megaxyela major*. The larvae of the Cimbicinae possess a spiracular gland located dorsad of each spiracle of abdominal segments 2-8. It is from these glands that the yellowish fluid of these larvae is poured out when disturbed. A peculiar sucker-like protuberance with a depressed center occurs in the larvae of the Acordulecerinae on the sublateral area of abdominal segments 2-4 or 5 and 8. The function of this structure is not known but it is not improbable that it is secretory in nature. The wax glands of the wax-secreting larvae such as certain Tenthredininae, Emphytinae, Selandriinae, etc., are minute and located on various parts of the body of these larvae, but their detailed structure has not been studied. The most common type of these glands is found in the larvae of the Diprioninae, Emphytinae, Selandriinae, Tenthredininae, some Nematinae, and others. The cutaneous glands of these larvae are provided with chitinized rings about their external openings. These chitinized openings are known as glandubae. They may be located at the end of tubular protuberances, and in such cases they are spoken of as being stalked, or they

may be found flush with the body surface, when they are spoken of as being sessile. The glandubae are especially conspicuous in the larvae of the Diprioninae and Pachynematus. The slime-glands of Caliroa have semi-sessile glandubae which are few in number. The glandubae are constant in their type, presence, general arrangement, and location, within genera and subfamilies.

Formulae of Segmented Appendages.—For convenience in designating the size and relationship of various segmented appendages, the resort has been made to various so-called formulae. The segments of an appendage are numbered, beginning with the proximal segment. In a formula numbers of the segments are arranged in the descending order of magnitude, and those of equal dimensions are placed in a parenthesis. For example, the expression "antennal formula: (2,5), 3, 4, 1" shows that the antenna is composed of five segments and that segments 2 and 5 are equal in length but longer than the others, and that segment 4 is shorter than segment 3 but longer than the first or proximal segment.

III. TAXONOMY

Strictly speaking no classification of the Tenthredinoidea based upon larval characters has hitherto been proposed. Attempts have been restricted to the characterization of the different subdivisions included in the superfamily. Among the earlier writers Le Peletier's (1823) work may be mentioned. After a brief general account of the larvae, he gave a list of eighteen divisions in which he grouped the species of the Tenthredinoidea and stated whether the larvae of each division were known or unknown and, if known, the number of the thoracic and abdominal legs present. It is interesting to note that he mentioned a group of larvae the body of which he characterized as "donkey-form" (aselliform) which he was unable to place in any of his divisions. Dahlbom (1835) published careful descriptions and a synopsis of larvae of sixty-three species. A synoptic table for the larvae was compiled by Westwood (1840) from this work and was published with additions. The characters used are the number of abdominal legs and the feeding habits of the larvae. Norton (1867) republished Westwood's table without additions. In the table given by Cameron (1882) the larvae of more than ninety-five species are included. The major groups are separated on the number of thoracic and abdominal legs present. These subdivisions are segregated on biological characters such as reflex bleeding, types of cocoons, and, finally, genera and species, when known, are separated on the coloration, setae, food-plants, and feeding habits. In 1895 Dyar, the most prolific and the only important American writer on the larvae of the Tenthredinoidea, published "A recognition table for the known sawfly larvae of the North Atlantic States." The larvae of one hundred and twenty-six species including forty-one not specifically identified were considered in this synopsis. The characters used are the number and location of abdominal legs, types of cocoon, feeding habits, food-plants, and coloration. This last character was employed extensively in separating different species. The next attempt along this line was undertaken by Chester Young (1898), who was the first to take into consideration the structural characters of the appendages of the head. Unfortunately this work remains unpublished, but it is on file as a baccalaureate thesis in the library of Cornell University. Konow (1901) summarized the taxonomic information concerning the known larvae of European and American species, four hundred and eighteen in all, in the form of an analytical table. The presence or absence of abdominal legs, number of antennal segments, and modifications and appendages

of the ultimate body-segment were used in separating the families and subfamilies. The number and location of abdominal legs, the food-plants, types of cocoon, and coloration furnished the basis for the separation of tribes, genera, and species. Middleton (1915, 1917) has characterized the larvae of the genus Dimorphopteryx and of the family Cephidae. It must be noted that these writers were concerned only in the preparation of recognition tables for the separation of the particular species they had in hand, and, with the exception of Middleton, no one has attempted to construct a synopsis of families, genera, and species as such.

In the following pages, the author has attempted to define and describe, as far as possible with the materials at hand, families, subfamilies, genera, and species by the use of larval characters. With a few exceptions, no attempt has been made to incorporate data from previous writers for the reason that the characters recorded by them were found in most cases of little or no value for the present purpose—not because they were inaccurate, altho that was true in many cases, but chiefly because they were not of specific significance. For example, Dyar's descriptions of species are usually very accurate and dependable but most of the characters noted excepting coloration often proved to be only of family or subfamily significance. The definitions given here are correct for the materials actually studied, but it is not surprising if they do not hold good in many cases when more materials become available for examination. It is obviously impossible to attain perfection in the face of so many missing links in the series of genera and species. These missing links will be filled in as rapidly as accurately identified materials become available, but it must be remembered that absolutely correct identification is only possible, in the majority of cases, after carrying individual larvae of the species thru to the adult stage, exuviae being saved for each instar.

In this study the classification of the Tenthredinoidea proposed by MacGillivray in 1906, with later additions, has been adopted in the main in arranging and restricting the families, subfamilies, genera, and species. For generic synonymy, Rohwer's "Genotype of the Sawflies and Woodwasps" (1911) has been followed. In this section all references to the bibliography of the different divisions and subdivisions have been omitted.

SUPERFAMILY TENTHREDINOIDEA

Larvae with exposed, well differentiated head, trunk consisting of three thoracic and ten visible abdominal segments; spiracles always present on prothorax and first eight abdominal segments; antennae and chitinized dentate mandibles always present; ocellarae, when present, always one on each side of the head; thoracic legs, when present, always three pairs, a pair to each segment; larvapods, when present, always six pairs or more, and except the Xyelidae, are never on the first and ninth abdominal segments, but always on the second abdominal segment, and never with crochets; mouth-parts, when normal, with mandibles strongly chitinized with distinct dentes, dextral dentes differing in number, shape, and arrangement from sinistral; maxillae with cardo, stipes, palpifer, palpus, galea, and lacinia present, palpus typically with four segments, galea conical, digit-like, and lacinia usually flattened, its cephalic margin with a fringe of setae; labium with submentum, mentum, palpi, stipulae, and totaglossa, palpi typically with three segments, totaglossa membranous, bulbose, with a sericos on its meso-distal portion; general appearance of body caterpillar-like or grub-like; free leaf-feeders, leaf-miners, web-spinners, leaf-rollers, wood- and stem-borers, and parasitic larvae.

Free Leaf-feeders.—Body caterpillar-like; thorax with well-developed, distinctly segmented legs, typically with five segments, coxa, trochanter, femur, tibia, and tarsus and tarsal claw; abdomen typically with a pair of larvapods on segments 2-7 or 2-8 and 10; ultimate segment sometimes with caudal protuberances but never with a distinct suranal process or with subanal appendages; head typically semiglobose; antennae typically multisegmented, segments one to five in number; ocellarae always present, usually located dorsad of antennariae; mouth-parts well developed and typical in structure; abdominal segments usually with five to seven annulets, some of which bear transverse rows of setae and often some glandubae; head, thoracic legs, and anal area usually setiferous; majority of Tenthredinidae and Xyelidae.

Leaf-miners.—Body somewhat depressed, head sometimes distinctly depressed and mouth-parts directed cephalo-ventrad; thoracic legs small, modified, number of segments reduced to four or to one, legs sometimes entirely fleshy, conical, or mamma-like, with or without tarsal claws; abdomen with very small larvapods or larvapods nearly obsolete; mouth-parts sometimes modified, labial and maxillary palpi with reduced number

of segments; annulation sometimes obsolete. A few subfamilies of Tenthredinidae.

Nest-builders.—Thorax with seta-like segmented legs; abdomen without larvapods; antennae long, setaceous, seven-segmented; mouth-parts normal; ultimate segment with distinct subanal appendages and a minute hook-like caudal process on caudo-meson of tergum; ocellarae present; web-spining leaf-rollers, Pamphiliidae.

Borers.—Thorax with rudimentary legs, tarsal claws never present; abdomen without larvapods, ultimate segment with a distinct suranal process or with a pair of subanal appendages; mouth-parts somewhat modified, maxillary and labial palpi reduced in number of segments; ocellarae wanting or with vestigial eye-spots; metaspiracles sometimes functional, as large as abdominal ones; wood-borers and stem-borers, Siricidae, Xiphydriidae, and Cephidae.

Parasites.—Body grub-like, thoracic and abdominal legs wanting; mouth-parts modified, maxillary and labial palpi obsolete; ocellarae wanting; antennae one-segmented; parasitic larvae, Oryssidae.

The larvae of the typical Tenthredinoidea are readily differentiated from the larvae of other Entometabola by the presence of a single ocellara on each side of the head and, usually, six or more pairs of larvapods, none of which are provided with crotchets, and never occur on first and ninth abdominal segments. The characteristic mouth-parts include four-segmented maxillary palpi and three-segmented labial palpi. The character of the antennae, the number of ocellarae and larvapods, the character of the mouth-parts, especially maxillary and labial palpi, and the presence of thoracic legs distinguish the leaf-miners and wood-borers of the Tenthredinoidea from other leaf-miners and wood-borers, such as certain Lepidoptera, Coleoptera, and Diptera. The larvae of Hymenoptera other than Tenthredinoidea are distinguishable from those of the latter as follows: They are apodous, thoracic and abdominal legs being always wanting; the mouth-parts are vestigial, maxillary and labial palpi, if present, papilliform, never distinctly segmented; ocellarae are never present; and suranal process and subanal appendages are always wanting. The larvae of the Oryssidae are separable from other hymenopterous larvae on the basis of the characters used in the definition of that family elsewhere.

FAMILIES OF TENTHREDINOIDEA

1(6) Thoracic legs present, either normal in form, distinctly segmented, or modified, if modified, fleshy or conical, if conical, head and body distinctly depressed; larvapods either present or wanting.....2.

2(5) Thoracic legs normal in form, not seta-like, rarely mamma-like; larvapods usually present; subanal appendages wanting; antennae usually with less than seven segments.....3.

3(4) Larvapods present on all abdominal segments; antennae with six or seven segments. XYELIDAE.
4(3) Larvapods not present on all abdominal segments; antennae never with more than five segments.....TENTHREDINIDAE.
5(2) Thoracic legs seta-like; larvapods wanting; subanal appendages present, setaceous; antennae very long, with seven segments.....PAMPHILIIDAE.
6(1) Thoracic legs vestigial, not distinctly segmented, mamma-like or wanting, if mamma-like, head and body never distinctly depressed; larvapods wanting.....7.
7(12) Thoracic legs present; ultimate segment with suranal process.....8.
8(9) Subanal appendages present, vestigial, papilliform; ocellarae present; antennae with four or five segments.....CEPHIDAE.
9(8) Subanal appendages wanting; ocellarae wanting.....10.
10(11) Antennae with three segments; metaspiracles functionless, very much smaller than abdominal spiracles.....11.
XIPHYDRIIDAE.
11(10) Antennae with one segment; metaspiracles functional, as large as abdominal spiracles.....SIRICIDAE.
12(7) Thoracic legs wanting; ultimate segment without suranal process and subanal appendages.....ORYSSIDAE.

MacGillivray (1906) divided the superfamily Tenthredinoidea into nine families. They are the Xyelidae, Pamphiliidae, Blasticotomidae, Tenthredinidae, Xiphydriidae, Siricidae, Megalodontidae, Cephidae, and Oryssidae. The first two families constitute his Generalized Tenthredinoidea and the last six his Specialized Tenthredinoidea. Since the Blasticotomidae and Megalodontidae belong to the Palearctic fauna and are not represented in North America, they are omitted from the foregoing table.

Family Xyelidae

Larvae (Fig. 6) of medium size, length 13-18 mm.; body caterpillar-like, subcylindrical, flattened on the ventral aspect, uniform in diameter except last two segments which are suddenly constricted, stout; segmentation and usually annulation distinct; cuticle smooth, tuberculate and setiferous, but never slimy; color greenish, yellowish, whitish, or brownish; tubercles, when present, brownish or blackish and setiferous; prothorax sometimes with a pair of lateral eversible cervical glands in the cervacoria; head circular in frontal contour, moderately large, width usually more than one-half the diameter of the thorax; mouth directed ventrad; head slightly overlapped by the prothorax, if any setae, sparsely and inconspicuously setiferous; antennae long, conspicuous, with six, sometimes seven, segments; ocularia about one-fifth the diameter of the antennaria and located caudo-dorsad of it, elevated, ocellarae very small; epicranial suture and vertical furrows present; mouth-parts normal in form; prothorax with a large, often colored, shield-like area on the dorsum and lateral aspects; legs in comparison with the size of the body very small, normal in form, all three pairs subequal in size; larvapods present on all

abdominal segments including the first and ninth, where they are sometimes reduced in size; typical segments with four annulets; spiracles on the second annulet; sublateral lobe produced ventrad, modified into a triangular lobe laterad of larvapod which it resembles in form; ninth abdominal tergum with three annulets; tenth abdominal tergum constricted distinctly and transversely on its cephalic fourth and with a distinct hump-like protuberance on the meson caudad of the cephalic constriction, concolorous with the head and setiferous tuberlces; anal larvapods and ventral or subanal lobes distinctly large, contiguous, forming a trilobate prominence on the meson of the tenth sternum; subanal lobe with a pair of setiferous protuberances dorsad of larvapods; insects single-brooded, solitary, chiefly exposed-feeders; pupate in earthen cells in the ground.

The Xyelidae is a small family consisting of seven genera and of a limited number of species, most of which belong to the North American fauna. The adults are readily distinguished from all other Hymenoptera by the presence of the free part of the vein R_2 in the wings. On venational characters, MacGillivray (1906) considers the members of this family to be the most generalized Hymenoptera known, having, "departed from the type of the wing assumed for the original progenitor of the Hymenoptera only in the loss of the free part of vein Cu_2." The genera, at the same time, possess many features of prominent progressive specializations which have proceeded in each case in a different sequence so that a linear arrangement of the genera does not express their true affinities.

Over twenty-five species have been reported from boreal America. Of this number, four species belonging to as many genera have been recognized in the larval state. Another unidentified species, feeding on pecan, is added in this paper. Dyar (1898) described the larvae of *Megaxyela major* and *Xyela minor* and gave a definition of the family based on characters found in these species. He pointed out that they are most nearly related to the Pamphiliidae. The larvae of *Odontophyes aviingrata* were described by the same author (1899). Konow (1901) overlooked Dyar's 1898 paper and gave in his analytical table for the larvae *Odontophyes aviingrata* as the sole representative of the subfamily Xyelini. That Konow was unfamiliar with any xyelid larvae may be reasonably assumed from the fact that he classified them with those larvae which had no larvapods and that he placed a question mark before the analytical item "ohne Afterborsten." The larvae of Pleuroneura, Paraxyela and Protoxyela are unknown. The described larvae feed on the foliage of hickory, butternut, pecan, elm, and the staminate flowers of pine.

The most important materials that I had in the study of this family were received from Professor R. W. Harned, of the Mississippi Agricultural College, but, altogether, the material at hand is so limited that it does

not permit a characterization of the genera. The following key will serve to separate the species:

1(8) Larvapods present on all abdominal segments, those on the first and ninth segment sometimes rudimentary; thoracic legs normal in form; body tuberculate, tubercles setiferous, concolorous with the head; head creamy or brownish or blackish; abdominal segments typically with four annulets, first annulet smooth, non-tuberculate, crescentic, and confined to the dorsal aspect, three following annulets convex, with transverse row of setiferous tubercles; not on staminate flowers of conifers.....2.

2(7) Head dark-colored, brownish or blackish; tenth abdominal tergum always and prothoracic and ninth abdominal terga usually with dark-colored patches; tenth tergum brownish or blackish; subanal lobe with a pair of wart-like brown tubercles which bear blackish brown setae on the dorsal and lateral aspects, less densely on the ventral aspect; dorsal tubercles arranged typically as follows: the second and third annulets with four to five, the fourth annulet with two or three; the subspiracular and surpedal lobes, each with a tubercle; the dorsal tubercles of the second annulet with one to three setae.....3.

3(6) Tubercles of typical abdominal segment arranged as follows: second and third annulets with four tubercles above the spiracular line, each tubercle bearing one seta, the fourth annulet with two tubercles, one on the spiracular line with two setae, the other, dorsad of the line, with one seta; on hickory and pecan.....4.

4(5) Prothoracic tergum with a large dark brown, median patch whose lateral margins converge toward the cephalic margin, which is one-half as long as the caudal margin; the ninth abdominal tergum with a large dark brownish patch on each side of the meson, the patches converging toward the caudal margin so that the caudal halves are nearly confluent on the meson with a pair of brownish tubercles btween the cephalic halves; tenth abdominal tergum almost completely dark brown in color; the first annulet of typical segment with the dorsal pair of tubercles quadrate, one-half as long as the annulet; abdomen with a brownish, cloudy, longitudinal dorso-lateral line involving the dorsal pair of tubercles and extending usually from the second abdominal segment to the seventh; on hickory and pecan; Y-226, G ..... *Megaxayela major* Cresson.

5(4) Prothoracic tergum without a large dark brownish median patch, but with a pair of small blackish patches distinctly separated on the meson of the first and second annulets, the cephalic pair larger, triangular, and their apices directed laterad, the caudal pair subquadrate, further apart than the cephalic pair; the ninth abdominal tergum without a pair of large dark brownish patches but with two pairs of small blackish patches, distinctly separated on the meson, the cephalic pair smaller and slightly further apart than the caudal pair; tenth tergum blackish, with its cephalic constricted portion pale or creamy; first annulet of typical abdominal segment with the dorsal pair of tubercles subcircular, one-third as long as the annulet; abdomen without a brownish, cloudy longitudinal dorso-mesal lines; on pecan; Y-227..... *Megaxyela* sp. 1.

6(3) Tubercles of a typical abdominal segment arranged as follows: second and third annulets with four to five tubercles above the spiracular line, each tubercle bearing two setae; the fourth annulet with three tubercles, one on the spiracular line and the other two dorsad of it, each tubercle with two setae; on hickory and butternut; Y-228.....*Odontophyes aviingrata* Dyar.

7(2) Head light in color, creamy white or pale brown; the prothoracic and the ninth and tenth abdominal terga without dark-colored patches; tenth tergum light brown; subanal lobe with a pair of wart-like creamy tubercles which bear long light brown

setae, uniformly distributed on all aspects; tubercles arranged as follows: the second and third annulets with four tubercles dorsad of the spiracular line, the second tubercle dorsad of the ventral one sometimes rudimentary and often represented by a single tiny seta, the fourth annulet with two tubercles, one on the spiracular line and the other dorsad of it, the sublateral area divided into three lobes and each with one tubercle; the dorsal pair of tubercles of the first annulet with four to five setae; on Ulmus; G..... *Macroxyela ferruginea* Say.

8(1) Larvapods very small; thoracic legs rudimentary; body not tuberculate; head creamy white; abdominal segments typically with three annulets; on staminate flowers of pine (Dyar in 1898 described no larvapods).....*Xyela minor* Dyar.

Family Blasticotomidae

The Blasticotomidae contains a single genus and species, *Blasticotoma filiceti* Klug, which is confined to central and eastern Europe. It is an archaic type. The systematic position of this unique species has been considered differently by practically every writer who has studied it. MacGillivray (1906) has shown, however, that it is in certain of its characters closely allied to the Xyelidae and Pamphiliidae, while in others it approximates the Tenthredinidae, and that, it is intermediate in position between these two groups.

Because of its taxonomic position, it is highly desirable to know the characters of the larvae of this species, but unfortunately the literature is void of information in regard to the immature stages, and this interesting quest must await future discoveries.

Family Tenthredinidae

Larvae (Figs. 7-25) very small to very large, length 10-40 mm.; caterpillar-like, leaf-feeders, leaf-miners, or fruit-borers; body cylindrical, thorax usually largest in diameter, body tapering caudad, sometimes flattened on the ventral aspect, leaf-miners depressed; greenish or variously colored with or without distinct markings; smooth, glabrous, setiferous, tuberculate, or spinous; segmentation usually and annulation sometimes distinct; third abdominal segment with 6, 7, 5, 4, 3, or 2 annulets, mentioned in the order of frequency; some of annulets usually setiferous and often with glandubae; thoracic legs always present, usually well developed, typically with five segments, sometimes with three, four, or six segments, but always with distinct tarsal claws; legs rarely rudimentary, fleshy, indistinctly segmented, and without tarsal claws; larvapods present usually on abdominal segments 2-7 and 10 or 2-8 and 10, occasionally the seventh and tenth pairs wanting, rarely with all larvapods obsolete; head typically semiglobose, setiferous, with or without distinct markings or uniformly brownish, blackish, or greenish; antennae always present, never with more than five segments; ocellarae always present, one on each side;

maxillary and labial palpi typically with four and three segments respectively, never obsolete, number of segments rarely reduced; clypeus usually with two or three setae on each side; mandibles usually with one to four setae; tenth abdominal tergum without suranal process and sometimes with caudal protuberances; subanal appendages never present; epicranial suture and vertical furrows usually present; metaspiracles functionless, obsolete, or very much smaller than abdominal spiracles; various glands sometimes present.

The family Tenthredinidae according to MacGillivray contains twenty-four subfamilies of which five are not represented in the Nearctic fauna. The subfamilies found in the United States and Canada are as follows: Diprioninae, Emphytinae, Selandriinae, Dolerinae, Phyllotominae, Lycaotinae, Tenthredininae, Cimbicinae, Hoplocampinae, Dineurinae, Monocteninae, Cladiinae, Nematinae, Blennocampinae, Fenusinae, Scolioneurinae, Hylotominae, Schizocerinae, and Acordulecerinae. Of these, Lycaotinae and Dineurinae have not been available for study.

SUBFAMILIES OF TENTHREDINIDAE

1(42) Thoracic legs normal in form, five-segmented; if modified, tarsal claws always present; larvapods usually well developed....2.

2(23) Larvapods present on abdominal segments 2-8 and 10; antennae elongate, conical, usually with five segments....3.

3(20) Thoracic legs with five segments, normal in form....4.

4(11) Third abdominal segment with six annulets on dorsum....5.

5(10) Antennae conical, with five segments....6.

6(9) Labrum bilaterally symmetrical; legs with tibia shorter than femur, tarsal claws short, strongly curved....7.

7(8) Body rather slender, tapering caudad, without small distinct tubercles; tenth abdominal tergum without small tubercles; head never shiny, jet-black, body never yellowish white....EMPHYTINAE (in part).

8(7) Body rather robust, uniform in diameter thruout, with small distinct tubercles; tenth abdominal tergum with several small protuberances, if without, head shiny, jet-black, body yellowish white....BLENNOCAMPINAE (in part).

9(6) Labrum not bilaterally symmetrical, but distinctly asymmetrical; legs with tibia longer than femur, tarsal claws slender, only slightly curved....DOLERINAE.

10(5) Antennae not conical, with three segments, the third segment erect and peg-like. DIPRIONINAE.

11(4) Third abdominal segment with more or less than six annulets on dorsum....12.

12(19) Third abdominal segment with seven annulets on dorsum; body without conspicuous branched spines or tubercles....13.

13(18) Antennae conical, with five segments; labrum without secondary longitudinal sutures....14.

14(15) Larvapods setiferous; clypeus with three setae on each side; mandible with two setae; labrum without a median longitudinal depression..SELANDRIINAE (in part). EMPHYTINAE (in part).

15(14) Larvapods glabrous; clypeus with two setae on each side; mandible with 1-4 setae; labrum with or without a median longitudinal depression....16.

16(17) Legs with tibia minute, distinctly shorter and smaller than femur; maxillae with stipes without cephalo-ventral triangular projection; mandibles with two setae; labrum without a median longitudinal depression.....17.
SELANDRIINAE (in part).

17(16) Legs with tibia large, usually subequal to or longer than femur; maxillae with stipes with cephalo-ventral triangular projection; mandibles with 1, 2, or 3-4 setae; labrum with or without a median longitudinal depression.....TENTHREDININAE.

18(13) Antennae not conical, with one segment; labrum with secondary longitudinal sutures; small but distinct crescentic glandubae dorsad of spiracles. CIMBICINAE.

19(12) Third abdominal segment with five, rarely three or four, annulets on dorsum; body with conspicuous branched spines or tubercles. BLENNOCAMPINAE (in part).

20(3) Thoracic legs with four segments, modified.....21.

21(22) Tenth urotergum and prothoracic and mesothoracic tergites with conspicuous fleshy pointed protuberances; body not tadpole-like.....EMPHYTINAE (in part).

22(21) Tenth urotergum and prothoracic and mesothoracic tergites without conspicuous fleshy pointed protuberances; body often distinctly tadpole-like.
PHYLLOTOMINAE (in part).

23(2) Larvapods on abdominal segments 2-7 and 10, rarely on segments 2-7 or 2-6 and 10.....24.

24(39) Thoracic legs with five segments, normal in form; larvapods on segments 2-7 and either with or without anal larvapods.....25.

25(36) Larvapods present on the ultimate segment, either normal and separated or fused on the meson, forming a single prominence.....26.

26(35) Anal larvapods normal and separated.....27.

27(28) Antennae with five segments; third abdominal segment with six annulets; tenth abdominal tergum with several caudal protuberances. HOPLOCAMPINAE (in part).

28(27) Antennae with four, rarely three, segments; third abdominal segment usually with less than six annulets; tenth abdominal tergum with or without caudal protuberances.....29.

29(32) Abdominal segments 1-7 on ventro-meson with an eversible gland; body often with numerous conspicuous setae, setae arising from distinct tubercles; antennae with four segments.....30.

30(31) Body with numerous conspicuous multisetiferous tubercles, each tubercle bearing several long setae, some of which are distinctly longer than others; third abdominal segment with four annulets, annulet 1 with a transverse row of setae, annulets 2 and 3 with a transverse row of setiferous tubercles; tenth abdominal tergum never with caudal protuberances altho with numerous long setae; setae barbed. CLADIINAE.

31(30) Body without numerous conspicuous multisetiferous tubercles, if tubercles present, they do not bear several long setae some of which are distinctly longer than others; third abdominal segment with varying number of annulets; tenth abdominal tergum sometimes with caudal protuberances; setae not barbed.....NEMATINAE.

32(29) Abdominal segments 1-7 on ventro-meson without an eversible gland; body never conspicuously setiferous; antennae with three or four segments; third abdominal segment with three or five annulets.....33.

33(34) Antennae with four segments; third abdominal segment with five annulets; abdominal segments 2-4 and 8 or 2-5 and 8 without a postsubspiracular sucker-like protuberance.....HOPLOCAMPINAE (in part).

34(33) Antennae with one segment; third abdominal segment with three annulets; abdominal segments 2-4 and 8 or 2-5 and 8 each with a postsubspiracular sucker-like protuberance.....ACORDULECERINAE.

35(26) Anal larvapods united on the meson forming a single protuberance; antennae with one segment; third abdominal segment with two annulets; prothorax often with dorsal and ventral shields; vertical furrows wanting; head and body depressed, glabrous.....SCOLIONEURINAE.

36(25) Larvapods wanting on ultimate segment; vertical furrows wanting.....37.

37(38) Antennae with three segments; third abdominal segment with four annulets, annulets 2 and 3 setiferous; tenth abdominal tergum with a caudo-mesal protuberance; body not depressed.....HOPLOCAMPINAE (in part).

38(37) Antennae with 1-2 segments; third abdominal segment with two annulets, annulets glabrous; tenth abdominal tergum without a caudo-mesal protuberance; body depressed.....FENUSINAE.

39(24) Thoracic legs with 3-4 or 6 segments; larvapods on abdominal segments 2-7 and 10 or 2-6 and 10, very small.....40.

40(41) Mesothoracic and metathoracic legs with six segments; prothoracic legs with six segments; larvapods on abdominal segments 2-7 and 10 and occasionally with a rudimentary eighth pair, or 2-6 and 10; body dilated laterad, sublateral lobe produced and conspicuous, often with numerous setiferous tubercles. HYLOTOMINAE.

41(40) Mesothoracic and metathoracic legs with three segments; prothoracic legs with four segments; larvapods on abdominal segments 2-7 and 10 with an occasional rudimentary eighth pair; body not dilated laterad, sublateral lobe not produced and conspicuous; body never with numerous setiferous tubercles but with minute protuberances.....SCHIZOCERINAE.

42(1) Thoracic legs not normal in form, but fleshy, indistinctly four-segmented, tarsal claws wanting; larvapods vestigial on abdominal segments 2-8 and 10, ultimate pair united on the meson, forming a single protuberance.....
PHYLLOTOMINAE (in part).

Subfamily Diprioninae

Larvae (Fig. 7) moderately large, length 18-25 mm.; body cylindrical, somewhat robust, tapering gradually caudad; segmentation and annulation distinct; third abdominal segment with six annulets, annulets 1, 2, and 4 or 2 and 4 with setae and glandubae; larvapods on abdominal segments 2-8 and 10, close together on the meson; thoracic legs normal, well developed, with five segments; prothoracic legs distinctly smaller than other legs; color of body usually yellowish or greenish, with grayish, or brownish stripes or rows of black spots; antennae with three segments, segments 1 and 2 minute, flat, irregular, incomplete, segment 3 erect, peg-like, strongly chitinized; head and legs usually with spinous, stiff setae; glandubae prominent and numerous; ventral glands wanting; spiracles not winged; cuticle microscopically spinulate; larvae feed on conifers.

The subfamily Diprioninae is represented in North America by three genera, Diprion, Neodiprion, and Monoctenus. The Neartic species formerly placed in the genus Diprion (Lophyrus) are placed by Rohwer (1918a) in Neodiprion. *Diprion simile* Hartig of Europe has recently become established in the United States. With the exception of MacGillivray, systematists agree in associating the genus Monoctenus with Diprion and its allies.

The three genera studied can be separated as follows:

1(2) Body large, stout, longer than 24 mm.; markings mottled with dark brown and yellowish irregular spots, without brownish stripes or black spots; setae on head small, slender, those on genae similar to other setae, not spinous; head blackish. *Diprion* Schrank.

2(1) Body smaller, slender, usually shorter than 24 mm.; markings not mottled, but with brownish longitudinal stripes or rows of black spots.....3.

3(4) Third abdominal segment with annulets 1, 2 and 4 with setae and glandubae; setae on head stiff, long, spinous, those on genae often very large and spinous..... *Neodiprion* Rohwer.

4(3) Third abdominal segment with annulets 2 and 4 with setae and glandubae; setae on head microscopic, and very few in number.....*Monoctenus* Dahlbom.

Neodiprion Rohwer

Larvae rather large; length about 19–24 mm.; body slender, with longitudinal brownish stripes or rows of black spots along subdorsal, supraspiracular, and sometimes subspiracular lines; head round in contour, cephalic and caudal margins parallel in profile; front flattened, subpentagonal, as high as wide; ocularia large; antennaria subequal in diameter to ocularia, their own diameter apart; labrum semicircular, with small crescentic median emargination; mandibles sharply dentate, the dextral with four dentes and the sinistral with five; maxillary palpi large, four-segmented, segments 1-3 ring-like, successively diminishing in diameter, segment 4 suddenly and distinctly smaller than the preceding segment, conical, bluntly pointed; galea chitinized, digit-like, smaller than palpi; lacinia thick, lobate, bearing a minute triangular blade-like seta on ventro-mesal angle, a stiff seta on dorso-mesal angle, and a row of three to five minute setae on the oblique cephalo-mesal margin; labial palpi normal, segment 2 usually longest, segment 3 conical, suddenly and distinctly smaller than preceding segment; totaglossa with dorso-cephalic depression on the meson and with several minute sensory pits; parapharynx distinct, linguiform, constricted dorsad of the middle by a pair of chitinized pieces; thoracic legs well developed, normal in form, usually blackish, segments strongly chitinized, coxae largest, trochanter ring-like, chitinized on the caudal two-thirds, with a whorl of setae, distad of setae membranous, femur smaller than trochanter in diameter, entirely chitinized, wider than long on dorsal aspect, increasing in diameter distad, tibia subequal in length to femur but smaller in diameter, tarsal claws small, basal portion of claw undeveloped, all segments of leg membranous on the ventral aspect, prothoracic legs one-half the size of metalegs, mesolegs slightly smaller than the latter; third abdominal segment with annulation formula, 2, 1, (3, 5, 6), 5; spiracle on annulet 2, annulets 1, 2 and 4 with a transverse row of slender, cylindro-conical glandubae, annulet 2 with a few microscopic setae; substigmatal and surpedal lobes large, with several glandubae

and a few setae; larvapods well developed, distal surface incurved mesad, rather dilated, not pointed, distance between the pair at the base less than the length of larvapod, venter with four annulets; tenth abdominal tergum gradually convex, with glandubae; anal setae numerous, small; spiracles elongate and oblong.

SPECIES OF NEODIPRION

1(10) Head black, light grayish or brownish, never uniformly reddish brown or orange; body longitudinally striped or spotted.....2.

2(3) Body with four longitudinal rows of black spots along subdorsal and supraspiracular lines; tenth abdominal tergum with cephalic two-thirds entirely black; spots on each side of dorso-meson elongate, wider at cephalic end; spots on supraspiracular line large, subquadrate; spots on prothorax obsolete; body yellowish white; length, 22 mm.; on Pinus; Y-221, G-573, C-1, I-4101.....*abbotii* Leach.

3(2) Body without four longitudinal rows of black spots along the subdorsal and supraspiracular lines, but with longitudinal colored bands along each side of the dorso-meson; latus with longitudinal row of independent segmentally arranged blackish or brownish spots or with continuous brownish bands.....4.

4(5) Body with a row of brownish spots along supraspiracular lines, spots segmentally arranged, one on each segment, often those on middle segments obsolete, sometimes all spots obsolete; tenth abdominal tergum with a pair of large blackish or brownish spots which are all sometimes contiguous on meson; subdorsal bands narrower than the distance between them; larvapods marked faintly along pedal line when supraspiracular spots are distinct; head black; length, 23 mm.; G-1686-2, -5. *Neodiprion* sp. 1.

5(4) Body with broad longitudinal bands along supraspiracular lines, instead of rows of segmentarly arranged spots.....6.

6(7) Subspiracular lines with broad brownish bands; head black; pedal lines also marked brown; tenth abdominal tergum faintly marked; subdorsal bands much wider than the distance between them; these bands much lighter in color than those on latus; body dull greenish; length, 21 mm.; on spruce; G-791.....*abietis* Harris.

7(6) Subspiracular lines without brownish bands; head light brown, brown, or pale creamy yellow; subdorsal bands very narrow or very wide; pedal lines with or without bands.....8.

8(9) Pedal lines with distinct brownish bands; tenth abdominal tergum unmarked except along caudal margin; subdorsal bands very much wider than the distance between them, lighter in color; head blackish or brownish with brown marks on vertex and front or pale brown; length, 19 mm.; G-156.....*Neodiprion*, sp. 2.

9(8) Pedal lines without distinct brownish bands; tenth abdominal tergum marked, entirely concolorous with head; subdorsal bands very narrow, usually narrower than the distance between them; head light brown or pale creamy white with vertex shaded grayish; length, 19 mm.; G-1686-3, -6, -7.....*Neodiprion* sp. 3.

10(1) Head reddish brown or orange; body spotted; subdorsal and supraspiracular lines with black spots.....11.

11(12) Subspiracular and pedal lines with black spots; spots on subdorsal lines tapering caudad, partly broken between annulets; spots along supraspiracular lines large, subquadrate; spots on subspiracular lines smaller, sometimes very small but never obsolete; spots on pedal lines very small, sometimes obsolete; tenth abdominal tergum with a pair of large black spots which sometimes fuse on the meson; length, 25-28 mm.; G-1554, -1686-8, -593, C-cue-315, C-Young-37.....*lecontei* Fitch.

12(11) Subspiracular and pedal lines without black spots; spots on subdorsal lines small, often not distinctly tapering caudad; tenth abdominal tergum with a pair of large black spots; length, 20 mm.; G-133.....*Neodiprion*, sp. 4.

Monoctenus Dahlbom

Larvae rather small; length about 15 mm.; body slender, dorsum with diffuse brownish shade or with longitudinal stripes; third abdominal segment with annulets 2 and 4 with setae and glandubae; head as in Neodiprion except that setae are minute and sparse; clypeus and labrum with two setae on each side; labrum with small crescentic median emargination; maxillary palpi large, rather slender, segments 1-3 ring-like, subequal in length but successively smaller in diameter; galeae and laciniae as in Neodiprion; labial palpi rather slender, its segments subequal in length; mandible with one mandibular seta; antennae with segment 1 complete, very narrow, oval, segment 2 flat, incomplete, irregular, segment 3 peg-like, erect; glandubae conical, distinct; setae microscopic; sublateral lobes not well developed; annulation typically (1, 2), (3, 4, 5, 6), anal setae numerous, short, and minute; telson with glandubae obsolete.

MacGillivray established in 1906 the subfamily Monocteninae for the genus Monoctenus associating it with the Cladiinae and Nematinae, thus deviating from the universal practice of regarding the genus Monoctenus as a member of the subfamily Diprioninae or its equivalent. On the basis of the venation, MacGillivray's contention is quite justifiable, and it is most interesting to know what larval characters would indicate in regard to the relationship between Monoctenus and Diprion and its allies. Marlatt (1887) published notes on the immature stages of *Monoctenus unicolor* but his descriptions do not touch the detailed anatomy necessary for the definition of the genus. Recently, however, I was fortunate enough, thru the courtesy of Mr. Rohwer, to examine a specimen belonging to the United States National Museum which Rohwer considered to belong to a new species of Monoctenus. A careful study of this larva convinced me that [so far as this species is concerned] there are no essential differences between the larvae of Monoctenus and those of the typical Diprioninae to justify the creation of a new subfamily. For this reason I have followed the universal practice and decided to treat Monoctenus as a member of the Diprioninae.

Monoctenus n. sp. Rohwer.— Length, 14 mm., head-width 1.5 mm.; head brownish; body on dorsum dorsad of spiracular lines, segments of legs, episternum and epimeron, deep brown; glandubae elongate, conical, minute, brownish at tip; on cedar.

A specimen bearing the label "5419 Sawfly on cedar, Cadek, Mo., June 10, 1892."

Diprion Schrank

As far as known, only one species is represented in North American fauna. An examination of *D. simile* shows that this genus is not very different from the other genera of Diprioninae but may be separated from them by the characters of the setae and coloration of the head, and certain minor points. It is not possible to characterize the genus with the material at hand.

Diprion simile Hartig.—Body robust, length, 25 mm.; latus with a series of yellowish or whitish spots on a uniformly grayish brown background, dorso-meson with a narrow yellowish stripe bordered on each side by an equally narrow grayish brown band; dorso-lateral lines broadly yellowish, interrupted at each annulet by fine transverse lines; supraspiracular lines with three yellow spots, size of spots increasing caudad; dorsad of these, three smaller spots with the middle one largest and subequal to cephalic spot of supraspiracular lines; three spots on subspiracular lines, the middle one being the largest; pedal lines with a large spot on each segment; larvapod with a brownish spot; tenth abdominal tergum and sternum marked with grayish; the tergum with a deep constriction dorsad of suranal lobe; head setae small, slender, hair-like, never spinous or stiff; setae on genae similar to those on front, never stiff and spinous; legs with femur sometimes longer than wide on the dorsal aspect; head black; body yellowish gray, mottled; G.

Subfamily Emphytinae

Larvae (Fig. 8) small to moderately large, usually greenish, sometimes striped; body cylindrical, slender, tapering caudad; segmentation distinct, annulation fine, indistinct; third abdominal segment usually with six, rarely seven, annulets, annulets 2 and 4 or 1, 3, 5 and rarely 1, 3, and 6 setiferous; head greenish or brownish; sometimes with spots on vertex and front; labrum with or without a mesal longitudinal depression, with 4-5 labral setae on each side of the meson; clypeus with 2 or 3 setae on each side; mandibles with one seta rarely with two; larvapods on abdominal segments 2-8 and 10, well developed, usually glabrous, rarely setiferous; ventral glands wanting; glandubae small, conical, on annulets 1 and 3 or rarely on 2 and 4; tenth abdominal tergum usually setiferous but without paired caudal protuberances, rarely with conspicuous spines on the caudal margin, if spines present, then prothorax and mesothorax on dorsum with two and one protuberances respectively; antennae elongate-conical, with five segments, segments ring-like; thoracic legs usually normal in structure, with femur subequal in length to or slightly longer than tibia, tibia well developed and normal, femur with its disto-ventral angle produced; legs, when modified, short, stout, and trochanter obsolete; mouth-parts normal in form, spiracles not winged; larvae leaf-feeders.

The Emphytinae is a large subfamily embracing a number of genera and numerous species. MacGillivray considers this the second subfamily of his generalized Tenthredinidae and places it between the Diprioninae and Selandriinae. The larvae of this subfamily are found readily and in general appearance and habitus resemble very closely the larvae of the Selandriinae and Tenthredininae, but they can be separated by the number of annulets, which in this subfamily, with the exception of Hemitaxonus and Epitaxonus, is six, while in the other two subfamilies it is seven. The two genera mentioned are characterized by the presence of seven annulets on the typical abdominal segment and also by the setiferous larvapods, thus resembling in these two particulars the larvae of the Selandriinae. It is of interest to note that Rohwer would associate Hemitaxonus with such genera as Selandria, Eriocampoides, etc., in the tribe Selandriini of his subfamily Selandriinae. Middleton (1915) has published a definition of the genus Dimorphopteryx together with a key for the separation of three species.

The writer has collected a large number of larvae belonging to this subfamily, but on account of the difficulty of breeding adults many species remain unidentified. In the preparation of the synoptic key to the genera and in discussions following, only bred or otherwise identified species have been considered, the consequence being that future study may require much modification in our conception of the various genera dealt with.

GENERA OF EMPHYTINAE

1(4) Third abdominal segment with 7 annulets; larvapods setiferous.....2.

2(3) Larvapods with 5-3-1 setae on cephalic, lateral, and caudal aspects respectively; thoracic legs with femur longer than or subequal to tibia; labial palpi with segment 2 longer than segment 1; maxillary palpi with segments subequal in length..... *Hemitaxonus* Ashmead.

3(2) Larvapods with 8-5-1 setae on cephalic, lateral, and caudal aspects respectively; thoracic legs with femur shorter than tibia; labial palpi with segments subequal to each other in length; maxillary palpi with segment 2 longer than segment 1..... *Epitaxonus* MacGillivray.

4(1) Third abdominal segment with 6 annulets; larvapods glabrous.....5.

5(26) Tenth abdominal tergum and prothoracic and mesothoracic tergites without conspicuous fleshy pointed protuberances; thoracic legs normal in form, with trochanters distinct.....6.

6(9) Annulets 1, 2, and 4 setiferous.....7.

7(8) Antennae with segment 5 longest; legs with femur longer than tibia; head usually without markings; labial palpi, if segments not subequal, segment 2 longer than segment 1.....*Empria* Lepeletier.

8(7) Antennae with segment 1 longest; legs with femur subequal to tibia; head usually with markings; labial palpi, if segments not subequal, segment 2 shorter than segment 1.....*Parataxonus* MacGillivray

9(6) Annulets 2 and 4 setiferous.....10.

10(11) Clypeus with three setae on each side of meson; mandibles with two setae; maxillae with palpifer produced dorsad as a triangular lobe; labrum with a deep median emargination with a row of secondary setae caudad of the emargination..... *Eriocampa* Hartig.

11(10) Clypeus with two setae on each side of meson; mandibles with one seta; maxillae with palpifer not produced dorsad as a triangular lobe; labrum without a deep median emargination.....12.

12(13) Thoracic legs with trochanter longer than tibia....*Strongylogastroidea* Ashmead.

13(12) Thoracic legs with trochanter distinctly shorter than tibia.....14.

14(15) Body spotted or transversely striped; head dorsad of ocellarae entirely blackish or brownish; very large and robust larvae.....*Macremphytus* MacGillivray.

15(14) Body never spotted or transversely striped; head dorsad of ocellarae not entirely blackish or brownish; smaller larvae.....16.

16(17) Labial palpi with segment 1 longer than segment 2; legs with femur always longer than tibia; tibia usually twice as long as trochanter; body rather robust; head not marked distinctly with brown; annulet 4 longest on third abdominal segment..... *Monostegia* Costa.

17(16) Labial palpi with segment 1 shorter than segment 2; legs with femur not always longer than tibia; tibia always more than twice as long as trochanter; body rather slender; annulet 4 not longest on third abdominal segment.....18.

18(19) Head entirely pale, no markings; legs with femur longer than tibia; body on dorsum not shaded darker than the venter; tenth abdominal tergum not marked..... *Monosoma* MacGillivray.

19(18) Head not entirely pale, usually with brown spots or markings; legs with femur not always longer than tibia, often subequal; body on dorsum sometimes shaded darker than the venter; tenth abdominal tergum often marked.....20.

20(21) Legs with femur always longer than tibia; tenth abdominal tergum usually marked; body on dorsum usually shaded darker than the venter.....*Emphytus* Klug.

21(20) Legs with femur subequal to or shorter than tibia; tenth abdominal tergum usually unmarked; body on dorsum not usually shaded darker than the venter.....22.

22(23) Tenth abdominal tergum marked with a spot; body on dorsum shaded darker than the venter; labial palpi with segment 2 longer than segment 1..... *Unitaxonus* MacGillivray.

23(22) Tenth abdominal tergum unmarked; body on dorsum not shaded darker than the venter; labial palpi with segment 2 subequal to or shorter than segment 1.....24.

24(25) Labrum with a distinct median depression.....*Taxonus* Hartig.

25(24) Labrum without a distinct median depression.....*Phrontosoma* MacGillivray.

26(5) Tenth abdominal tergum and prothoracic and mesothoracic tergites with conspicuous fleshy pointed protuberances; thoracic legs not normal in form, with trochanters obsolete.....*Dimorphopteryx* Ashmead.

Subfamily Selandriinae

Larvae (Fig. 9) small to fairly large, length 18-26 mm.; body cylindrical and gradually tapering caudad; segmentation and annulation distinct and fine; larvapods on abdominal segments 2-8 and 10; third abdominal segment with seven annulets, annulets 1, 3, and 5 setiferous, annulets 3 and 5 with glandubae; thoracic legs normal in form except tibia sometimes very minute; body uniformly greenish, without colored markings; head with or without brownish spots; antennae with five segments, long, conical;

mouth-parts normal in form, well developed, palpi large; mandibles with two setae; clypeus with three, sometimes four, setae on each side, rarely with two; stipes of maxillae with triangular cephalo-ventral projection; glandubae minute, stalked; spiracles not distinctly winged; larvapods setiferous, with about ten setae, rarely glabrous.

The Selandriinae includes a limited number of genera. On the basis of the venation this subfamily is placed next to the Emphytinae where practically all systematists have placed it. Rohwer's conception of this subfamily is somewhat different from that of MacGillivray and therefore he differs from the latter in the disposition of some of the genera. For example, Hemitaxonus is assigned to the tribe Selandriini while MacGillivray placed it, together with Epitaxonus, in the Emphytinae. It may be said that the larvae of these two genera are very closely related to the Selandriinae and differ from all other Emphytinae in the typical number of annulets.

GENERA OF SELANDRIINAE

1(4) Thoracic legs with tibia normal in form, never greatly reduced, usually subequal in length to femur; larvapods setiferous; clypeus with three or four setae on each side.....2.

2(3) Tenth abdominal tergum with brown spots; larvapods usually with ten or more setae; clypeus usually with three and often four setae on each side; labium deep brown, with four to six setae on each side; glandubae slightly longer than one-half the length of adjacent setae; spiracles not winged; larger larvae; length more than 24 mm.....*Thrinax* Konow.

3(2) Tenth abdominal tergum not marked with brown spots; larvapods usually with less than ten setae; clypeus with three, rarely with four, setae on each side; labium pale brown or whitish with three to six setae; glandubae usually subequal in length to adjacent setae; spiracles faintly winged; smaller larvae; length less than 24 mm. *Strongylogaster* Dahlbom.

4(1) Thoracic legs with tibia reduced, very much smaller than femur; larvapods glabrous; clypeus with two setae on each side.....*Selandria* Leach.

Thrinax Konow

Larvae comparatively large, long, length more than 24 mm.; body slender, finely annulate, uniformly greenish; head and tenth abdominal tergum with brown markings; thoracic legs normal, tibia and femur cylindrical, tapering caudad, subequal in length; larvapods with about ten setae, distributed as follows: 4-5 on cephalic and lateral aspects and one on caudal; clypeus usually with three and often with four setae on each side; labrum with four to six setae on each side, deep brown, without median longitudinal depression; glandubae small, very short, slightly longer than one-half the length of adjacent setae; spiracles not winged; maxillary palpi with segments 2 and 4 subequal in length; labial palpi with segment 4 longer than segment 3; ninth abdominal tergum with six annulets, annulets 1, 3, and 5 setiferous, annulet 6 a little shorter than the second.

SPECIES OF THRINAX

Head pale brown with vertex marked with brown on dorsum and caudad of ocellarae, front with a round brown spot contiguous to ventral apex of the dorsal marking on the vertex, frontal spot not reaching the fronto-clypeal suture; antennae, mouthparts, femur, tibia, and tarsal claw deep brown; tenth abdominal tergum with a pair of small brown spots; annulation formula, 1, (5, 4, 3), 2, (6, 7); antennae, 5, 4, 3, 2, 1; labial palpi with distal two segments subequal; legs with trochanter, femur, and tibia with lengths to each other as 12, 15, and 16 respectively; tarsal claws with the proximal portion shorter than the distal narrow curved portion; length 26 mm.; width of head 2 mm.; on fern; M-18.....*impressatus* Provancher.

Head pale brown with vertex marked with brown on dorsum and caudad of ocellarae, front with a subquadrate spot contiguous to the ventral apex of dorsal marking of the vertex, frontal spot reaching the fronto-clypeal suture; antennae, labrum, mouthparts, femur, tibia, and tarsal claw deep brown; tenth abdominal tergum with a pair of large brown spots; annulation, 1(5, 4, 3, 1), (6, 7); antennae, 5, 4, 1, 3, 2; labial palpi with distal segment longer than the preceding; legs with trochanter, femur, and tibia with lengths to each other as 12, 15 and 16 respectively; tarsal claws with the proximal portion as long as the distal curved portion; length 25 mm.; width of head, 2 mm.; on fern; Y-20-3-1, -20-1.....*pulatus* MacGillivray.

STRONGYLOGASTER DAHLBOM

Larvae small comparatively speaking, length less than 24 mm.; body slender, finely annulate, uniformly green; head pale or light brown or sometimes with a few spots; tenth abdominal tergum never distinctly marked; larvapods usually with less than ten setae; thoracic legs normal in form, femur and tibia subequal to each other or one longer than the other; labrum pale brown or whitish, with three to six setae on each side; glandubae usually subequal in length to adjacent setae; spiracles often faintly winged.

SPECIES OF STRONGYLOGASTER

1(2) Head with blackish brown markings, vertex with a pair of diverging spots over the vertical furrows directed toward ocellarae and a spot caudad of each ocellara; vertical markings sometimes faint, sometimes very distinct and large, merging into a continuous vertical marking; front never with spot; antennae, labrum, and mouthparts light brown; tenth abdominal tergum usually without markings, rarely with a pair of faint spots; annulation, 1, 4, (2,3, 5), (6, 7,); antennae, 1, 5, (2, 3, 4); maxillary palpi, 2, (1, 4), 3; labial palpi with two distal segments equal in length to each other, shorter than distal segment of maxillary palpi; labrum with three or four setae on each side; mandible with two, rarely three, setae; legs with trochanter, femur, and tibia with lengths to each other as 10, 10, and 12 respectively; uropods with about eight or nine setae, five on cephalic, 3-4 on lateral, and one on caudal aspect; glandubae long, slender, subequal in length to adjacent setae; spiracles not winged; length 18 mm.; width of head 1.8 mm.; on *Pteris aquilina;* Y-21.....*annulosus* Norton.

2(1) Head without blackish brown markings, uniformly pale brown.....3.

3(4) Trochanter distinctly shorter than femur; labial palpi with distal segment as long as the preceding segment; head uniformly pale; body and legs uniformly green without markings; annulation, 1, (3, 4, 5), (6, 7, 2); antennae slender, 5, 1, (4, 3, 2); maxillary palpi, (2, 1), (4, 3), distal segment longer than that of labial palpi; labrum

and clypeus with four and three setae respectively on each side; larvapods with about 6-8 setae, 4-5 on cephalic, 2-3 on lateral aspect; glandubae subequal in length to adjacent setae; spiracles with faint brown wings; thoracic legs with trochanter, femur, and tibia with lengths to each other as 8, 13, and 15 respectively; length, 19 mm.; width of head, 1.6 mm.; on *Pteris aquilina;* Y-168-4.....*tacitus* Say.

4(3) Trochanter not distinctly shorter than femur; labial palpi with distal segment shorter than the preceding segment; head uniformly pale, rarely with a pair of faint spots on dorsal part of vertex; body uniformly green; legs distad of trochanter brownish; annulation, 1, (5, 4, 3), (2, 6, 7); antennae, slender, conical, (5, 1), 4, (2, 3); maxillary palpi, 2, (4, 1), 3, distal segment subequal to that of labial palpi; labrum and clypeus with four and three setae respectively on each side; thoracic legs with trochanter little shorter than femur, tibia usually almost as long as femur; length, 21-23 mm.; width of head, 1.8 mm.; on *Pteris aquilina;* Y-18-1, M-32 (in part), M-86. *politus* Provancher.

Selandria Leach

Larvae comparatively small, length less than 24 mm., usually about 15 mm.; body slender, finely annulate; head pale; body green; tenth abdominal tergum unmarked; larvapods glabrous; legs very short, with tibia conspicuously reduced in size, femur distinctly dilated at distal end, bearing rudimentary tibia on dorsal margin; clypeus with two setae on each side; mandible with two setae; labrum with three setae on each side; glandubae very small; spiracles not winged.

Selandria flavipes Norton.—Legs with trochanter ring-like, femur dilated at distal end, with ventro-mesal projection only slightly narrower in diameter than trochanter; tibia very small, much smaller in diameter than femur, appearing as if surrounded by fleshy part of the latter, deep brown in color; trochanter, femur, and tibia with lengths to each other as 7, 11, and 6, respectively; annulation, 1, 4, 2, (3, 5, 6, 7); antennae slender, conical, 5, (1, 2, 4, 3); maxillary palpi, (4, 1, 2), 3; labial palpi with distal segment subequal in length to segment 1, longer than distal segment of maxillary palpi; length, 15 mm.; width of head 1.3 mm.; on *Pteris aquilina:* Y-168, M-70, C-S.f.

Subfamily Dolerinae

Larvae (Fig. 10) moderately large, length, 15-25 mm.; body slender, cylindrical, tapering uniformly and gradually caudad, either uniformly greenish or brownish, or dorsum colored darker than venter, never with bright and distinct patterns; segmentation and annulation distinct; third abdominal segment with six annulets, annulets 2 and 4 on dorsum setiferous and with glandubae; larvapods on abdominal segments 2-8 and 10; thoracic legs well developed; head large, as wide as thorax or nearly so; vertical furrows distinct; antennae five-segmented, conical; labrum distinctly asymmetrical, dextral part larger than sinistral; head, legs, larvapods, tenth abdominal tergum, and sternum moderately setiferous; glandubae present; spiracles not winged; cuticle distinctly, uniformly, micro-

scopically verrucose on the dorsum and latus between spiracular lines; on monocotyledonous plants.

The Dolerinae is a well-defined subfamily with a distinct habitus and is closely allied to the Emphytinae and Selandriinae. The most important adult character for differentiating the group from other subfamilies of the generalized Tenthredinidae is the coalescence of the cells R_4 and R_5 due to the atrophy of the free part of the vein R_5. The subfamily contains two genera, the old genus Dolerus and the recently described genus Loderus. Leach separated, under the name of Dosytheus, all those species having certain antennal peculiarities and, according to Stephens, also having bright colors on the abdomen. This differentiation was considered invalid by Hartig and his view was endorsed by Norton and Cameron. Norton described a species under the name of *Dorytheus apricus* var. *albifrons* which is now placed in the genus Loderus. The monobasic genus Pelmatopus of Hartig, based on *P. minutus*, is now considered as congeneric with Dolerus. Since the larvae of Loderus are unknown, the genus Dolerus alone is considered here.

Dolerus Jurine

Head viewed from cephalic aspect circular in contour in mature specimens, epicranium semiglobose, front distinctly flattened; mouthparts directed caudo-ventrad; antennaria never circular, with obtuse corners at the angles of their dorsal side; antennae with formula, 5, (3, 4, 2), 1, distal segment conical, apex less chitinized and obtusely rounded, never sharply pointed, segments 2-5 well chitinized, segment 1 narrow but distinctly larger in diameter than distal segments; front distinctly wider than high; labrum asymmetrical, dextral part always larger than sinistral or with pointed ventro-mesal angle; mandible very thick, large, dextral with four distadentes and one curved sharp proxadentis, sinistral with four distadentes and mesal surface deeply emarginate; parapharynx with apex dilated and chitinized; maxillary palpi, galea, lacinia, and labial palpi normal in structure and well chitinized; thoracic legs with femur often produced papilla-like on its disto-ventral angle, tibia long, cylindrical, tapering uniformly distad, distinctly longer than femur, tarsal claw rather slender and straight; abdominal segments with six annulets, typical formula, (1, 2), 3, 4, (5, 6), $1=5+6$; spiracles on annulet 2; annulets 2 and 4 with conical glandubae and tiny cylindrical truncate setae with large calices; tenth abdominal tergum semiglobose, anal setae numerous; ventral glands never present.

The genus Dolerus is represented in North America by more than thirty species but none of them had been identified in the immature stages until the writer reared the adult of *D. similis* Nort. at Ithaca, N. Y. The

larvae of this genus are easily obtained and readily identified because of the marked asymmetry of the labrum.

The following key will serve to separate the species studied:

SPECIES OF DOLERUS

1(6) Head uniformly pale, creamy, or pale brown; body uniformly whitish or greenish, without distinct dorsal band....2.

2(3) Body with small black spots on each segment along supraspiracular and pedal lines; head pale brownish yellow; spots on ninth abdominal segment much smaller than preceding ones; length, 25 mm.; on wheat and grasses; Y-117-1-1, G-d-1. *Dolerus* sp. 1.

3(2) Body without small black spots on each segment along supraspiracular and pedal lines; head creamy; length less than 25 mm....4.

4(5) Distance between antennaria and mandibularia subequal to distance between antennaria and ocularium; length, 20 mm.; on *Carex trichocarpa;* Y-24-5-2, -145-1(?),-147. *Dolerus* sp. 2.

5(4) Distance between antennaria and mandibularia twice or more than twice the distance between antennaria and ocularium; length of prothoracic spiracles in relation to vertical diameter of antennaria variable; femur with or without disto-ventral projection; front with or without pale brown spot; length 18-20 mm.; on grasses, sedge, timothy; Y-29-11,-32-1, M-7, H,-41-1,-63,-225....*Dolerus* sp. 3

6(1) Head spotted, banded, or distinctly brown, black, or purple; body uniformly longitudinally banded or striped on dorsum, especially along dorso-lateral lines, rarely uniformly whitish or greenish....7.

7(8) Head with a distinct blackish semicircular band extending from gena to gena dorsad of front and involving ocellarae; body with a very fine brownish line along latero-dorsal lines, more distinct on caudal segments; thoracic legs uniformly pale; length, 15 mm.; on grasses; Y-41-1-1,-41-2,-41-3,-8.47(?) M-41,-235....*Dolerus* sp. 4.

8(7) Head without distinct blackish semicircular band, but with spots or dark-colored areas; thoracic legs with femur, tibia, and claws brown, not concolorous with coxa..9.

9(12) Head pale brown, vertex with brown spots; body uniformly whitish or with light dorsal band....10.

10(11) Vertex with two small spots, one dorso-mesad of each vertical furrow, variable in size but never linear along the furrow; body uniformly whitish or creamy; length. 21 mm.; on Carpinus and *Pteris aquilina* (both doubtful); Y-74-1-1, M-82.... *Dolerus* sp. 5.

11(10) Vertex with one minute spot at the origin of epicranial stem; light brown spot along epicranial suture to ocellarae; body with dorsal band lighter on dorso-meson and darker on supraspiracular lines, more distinct on caudal segments; length, 15 mm.; on *Equisetum arvense;* Y-145-2....*Dolerus* sp. 6.

12(9) Head brownish with purplish or brownish markings on vertex, only rarely light brown or yellowish, then vertical furrows with brownish streaks; body with distinct dorsal band....13.

13(14) Head deep purplish black with following parts whitish: proximal half of epicranial stem, vertical furrows, vertex caudad of ocellarae to the middle of epicranial stem very narrowly, epicranial arms, clypeus, and labrum; dorsal band lighter on dorso-meson; pedal lines with a row of grayish patches; legs with femora without disto-ventral projection; length, 19 mm.; on *Equisetum arvense;* Y-146-1-2..*similis* Norton.

14(13) Head usually brownish or yellowish, vertex deeply brown, at least along vertical furrows; typically pale on vertex ventrad of vertical furrows and caudad of ocellarae; front with or without brownish spot; tenth abdominal tergum on both sides usually

more brownish than on meson; legs with femora without disto-ventral projection; length, 20-23 mm.; on sedges; Y-28-1,-27-1-1,-30,-210-1-8.32 (?)-1-1, M-7,-8,-9,-35, -64,-193,G-d-3.....*Dolerus* sp. 7.

Subfamily Phyllotominae

Larvae (Fig. 11-12) small, length usually less than 15 mm.; body subcylindrical or depressed, without colored patterns; larvapods on abdominal segment with two or six annulets; antennae with 3-4 or 5 segments; thoracic legs with four segments, short, stubby, with or without tarsal claws.

The Phyllotominae can be divided into two distinct tribes on the basis of the larval characters. The tribes can be separated as follows:

Thoracic legs with tarsal claws; head normal in form, not depressed; third abdominal segment with six annulets; external feeders.....Phyllotomini.
Thoracic legs without tarsal claws; head depressed; third abdominal segment with two annulets; leaf-miners.....Phlebatrophini.

The Phyllotominae is a distinct group and includes four genera, Phyllotoma, Caliroa, Endelomyia, and Phlebatrophia. In the Nearctic region, the last three genera are represented by a limited number of species. MacGillivray considered this family as one of the five generalized subfamilies of the Tenthredinidae, quite apart from the Fenusinae and Scolioneurinae, but Rohwer would associate them in his subfamily Messinae while Konow would include Hoplocampinae and Phyllotominae in his tribe Hoplocampides. The subfamily is divisible into two distinct groups according to the characters of the larvae. The remarkable specialization of structures due to the leaf-mining habit of the larva in one genus where specialization has proceeded much further than in any of the other leaf-miners, makes the division of the subfamily into two tribes desirable.

Tribe Phyllotomini

Body practically subcylindrical, thorax distinctly swollen, sometimes distinctly tadpole-like, tapering caudad; segmentation and annulation indistinct, fine, subequal in length; third abdominal segment with six annulets, annulets 2 and 4 microscopically and sparsely setiferous or minutely tuberculate; tenth abdominal tergum with or without tubercles; thoracic legs as long as head is wide, subequal in size, short, modified, with four segments, stubby, with distinct tarsal claws, coxa conical, femur cylindrical, as long as wide, tibia convex, wider than long, distal segment very minute, with sharp incurved claw; larvapods on abdominal segment 2-8 normal in form, glabrous, distal lobe with a minute point on its cephaloventral angle; ultimate segment with a pair of normal larvapods or without any; head small, normal, not depressed, sparsely setiferous, longer than

wide, slightly pointed at dorsal apex; mouth directed slightly ventro-caudad; antennae with four or five segments, slender, elongate, conical, or subconical; mouth-parts normal in form; spiracles with or without wings; ventral glands wanting; prothoracic glands sometimes present; glandubae present, conical, tuberculate or sessile; cuticle usually microscopically verrucose; larvae in life sometimes distinctly slimy; subgregarious; leaf-skeletonizers.

GENERA OF PHYLLOTOMINI

Body without minute tubercles, tadpole-like, slimy; glandubae sessile.....*Caliroa* Costa.
Body with minute tubercles, not tadpole-like, not slimy; glandubae conical, tuberculate. *Endelomyia* Ashmead,

ENDELOMYIA ASHMEAD

Larvae small, length less than 15 mm., greenish yellow; body subcylindrical, apparently almost glabrous, not tadpole-like, thorax thickened, tapering caudad; third abdominal segment with six annulets, annulets 2 and 4 tuberculate; tenth abdominal tergum with eight to ten conical tubercles arranged approximately in three transverse rows; suranal and subanal lobes with several rather long stiff setae; thoracic legs with distinct tarsal claws; larvapods on ultimate segment normal in form, separated; antennae with five segments, slender, elongate-conical; mandibles with dentes; spiracles not winged; spiracles on sublateral lines; prothoracic glands wanting; glandubae conical, tuberculate; body not slimy.

Endelomyia aethiops Fabricius.—Length, 13 mm.; width of head, 1.2 mm.; head light brown; mouth-parts, labrum, and tarsal claws deep brown; body greenish yellow to yellowish white; tubercles concolorous with body; typical tubercular formula on prothorax: 3-6 on first annulet, 2-3 on prosubspiracular lobe, 2-5 on annulet 2; third abdominal segment with 2 and 3 tubercles on annulets 2 and 4 respectively, 1 on annulet 3 near the spiracle, 1 each on subspiracular and surpedal lobe; annulation, 1, 2, 3, 4, (5, 6); antennae, 1, (2, 3, 4), 5; maxillary palpi, (1, 2, 3), 4; labial palpi, 1, 2, or (1, 2); subgregarious; on Rosa; Y-2, M-127.

CALIROA COSTA

Larvae small, length 6–12 mm., whitish; body distinctly tadpole-like; thorax conspicuously swollen, rounded on dorsum and flattened on venter; tapering distinctly caudad; third abdominal segment with six indistinct annulets, annulets 2 and 4 with a few glandubae; tenth abdominal tergum without tubercles; suranal and subanal lobes often with a number of stiff rather long setae; thoracic legs with distinct tarsal claws; larvapods on ultimate segment obsolete, their position indicated by a small median swelling; antennae with four segments, rather thick, elongate, distal segment microscopic; mandibles with dentes; spiracles usually winged;

spiracular line abnormally low in position, coinciding with latero-ventral line; prothoracic glands present, large, triangular, fleshy, attached cephalomesad of prothoracic legs; glandubae sessile;

SPECIES OF CALIROA

1(2) Anal setae not all of same type and length, longer ones arising from minute but distinct tubercles, brown, apparently barbed, curved at tips, as long as labrum, ten to twelve in number, arranged in a transverse row on suranal and subanal lobe; spiracles distinctly winged, brown; clypeus light brown; head deep brown; thoracic legs and antennae deep brown; smaller setae on anal area normal in form, much shorter than the long barbed ones, scattered beyond the transverse rows; lengths of front, clypeus, labrum, and width of labrum to each other as 23, 10, 8 and 12 respectively; length of body, 11 mm.; width of head, 1 mm.; on cherry, plum, Crataegus; Y-209, M-260,-249,-115, C-551,-552 ..... *cerasi* Linnaeus.

2(1) Anal setae all of same type and length, none arising from distinct tubercles and barbed, all of normal type, much shorter than labrum; spiracles usually not winged. 3.

3(8) Head blackish, deep brown, or brownish; legs brownish in part, not concolorous with body ..... 4.

4(7) Head blackish or dark brownish ..... 5.

5(6) Head black or dark brownish black; anal setae scattered, pale, subequal in length, about three-fifths as long as labrum; prothoracic legs distinctly lighter in color than other legs, which are brownish; spiracles of cephalic segments faintly winged; clypeus whitish; lengths of front, clypeus, labrum, and width of labrum to each other as 22, 9, 8, and 11, respectively; length of body, 10.5 mm.; width of head, 1 mm.; on oak; M-157,-200,-245, G-553c, Y-mck ..... *Caliroa* sp. 1.

6(5) Head deep brown; anal setae scattered, subequal in length; prothoracic legs higher in color than other legs; spiracles never winged; anal setae about one-third as long as labrum; clypeus pale brown; lengths of front, clypeus, labrum, and width of labrum to each other as 18, 10, 8, and 11 respectively; length of body 6 mm.; width of head, .9 mm.; on wild cherry; C ..... *obsoleta* Norton.

7(4) Head brownish or light brown; all legs pale brownish; anal setae scattered, subequal in length, about one-third as long as labrum; clypeus pale brown; lengths of front, clypeus, labrum, and width of labrum to each other as 10, 9 ,7, and 11, respectively; length of body, 8 mm.; width of head 1 mm.; on white oak and Crataegus; C-7, M-230 ..... *quercus-alba* Norton.

8(3) Head pale brown or whitish; legs whitish, concolorous with body; spiracles not winged; anal setae scattered, subequal in length, about three-fifths as long as labrum; lengths of front, clypeus, labrum, and width of labrum to each other as 21, 9, 7, and 10, respectively; length of body, 10.5 mm.; width of head, 1 mm.; Y-121, G-553c, M-143,-201,-231,-236-242 ..... *quercus-coccinea* Dyar.

TRIBE PHLEBATROPHINI

Body viewed from the side distinctly depressed, venter flattened, thorax thickened, broadest on mesothorax, prothorax declivous cephalad, caudal segments distinctly tapering; segmentation and annulation distinct; third abdominal segment with two annulets, annulet 2 sparsely and inconspicuously setiferous; tenth abdominal tergum without tubercles; tenth sternum small; thoracic legs modified, fleshy, indistinctly four-segmented,

tapering to distal end, distal segment microscopic, mamma-like, without tarsal claw; larvapods vestigial, located on abdominal segments 2-8 and 10, anal larvapods united on the meson, forming a single sucker-like protuberance; head distinctly depressed, pointed, subtriangular in contour, partly overlapped by protruding prothorax; mouth directed cephalad; vertical furrows obsolete; antennae with 3-4 segments, segments 1 and 2 large and conical, segments 3 and 4 subcylindrical and much smaller and less in diameter than proximal segments; mouth-parts modified, mandibles slender, sharply pointed, without dentes, blade-like; labium flattened and large; spiracles not winged; ventral and prothoracic glands wanting; glandubae obsolete; body not slimy; leaf-miners.

Phlebatrophia MacGillivray

Larvae very small, whitish; length less than 10 mm.; body distinctly depressed, tapering much caudad, broadest on mesothorax, prothorax declivous cephalad; lateral lobes somewhat prominent; tenth abdominal tergum convex, almost glabrous, about half as wide as mesothorax; suranal and subanal lobes semiglabrous; third abdominal segment with two annulets, caudal annulet about four times as long as the cephalic, microscopically and sparsely setiferous; thoracic legs fleshy, tarsal claws wanting; larvapods rudimentary; ocularia protruding, located laterad of antennariae; epicranial suture in part obsolete; spiracles not winged; spiracular line normal in position; maxillary palpi with four segments, labial palpi with two segments; totaglossa roundly protruding; stipes elongate, subgalea long, slender, with distinct chitinized carinae; labrum flattened; mandibles slender, sharply pointed, without dentes, blade-like; leaf-miners.

Phlebatrophia mathesoni MacGillivray.—Length, 7 mm.; width of head, 1 mm.; mesothorax, 2.4 mm. wide; head light brown, mandibles and carinae of subgalae deep brown; maxillary palpi typically 2, 1, 3, 4, distal segment very minute; antennae with proximal segment or segments larger in diameter and fleshy, conical, two distal segments together smaller and shorter than the other two segments, but longer than labial palpi; distal segment of labial palpus very minute; leaf-miners of birch; C and G.

Subfamily Tenthredininae

Larvae (Fig. 13) of medium to rather large size; body cylindrical, slender, tapering uniformly and gradually caudad; segmentation and annulation distinct, fine; third abdominal segment with seven annulets, annulets 1, 3, and 5 setiferous and 3 and 5 with transverse row of glandubae; abdominal segments 2-8 and 10 with larvapods; antennae with five segments, slender, cylindro-conical; body uniformly greenish, with dark

dorsal band or with complicated color-patterns; tenth abdominal tergum convex, suranal or caudal protuberances wanting; ninth abdominal tergum with six annulets, annulet 6 as long as annulet 2; thoracic legs normal, well developed, femur with ventro-distal, conical membranous projection; clypeus with two setae on each side; labrum with 3-5 setae on each side, with or without a median longitudinal depression; maxillary palpi slender, normal; galea digit-like, large; lacinia flattened, with a row of 10-15 setae on the oblique, truncate cephalic margin; stipes with a sharp triangular cephalo-ventral projection; labial palpi long, slender, with segment 2 longer than segment 1; mandible with 1, 2, or 3-4 setae; head variously marked, distinctly and densely setiferous; spiracles on third annulet, not winged; larvapods glabrous; glandubae distinct, slender, elongate cylindro-conical, sometimes longer than adjacent setae; cuticle microscopically and densely spinulate; ventral glands wanting; larvae free leaf-feeders.

The Tenthredininae constitutes, according to MacGillivray, the second subfamily of the series of specialized Tenthredinidae. Rohwer (1911) would divide the subfamily into two tribes, Perineurini and Tenthredinini, using the position of the propodeal spiracles and shape of the cephalic margin of the scutellum as characters for differentiating them. In many cases the larvae resemble those of the Emphytinae.

GENERA OF TENTHREDININAE

1(4) Mandibles with more than one seta; labrum with median longitudinal depression; legs with dorsal aspect of femur usually less than twice as long as trochanter, but often subequal to it.....2.

2(3) Mandibles with two setae.....*Macrophya* Dahlbom.

3(2) Mandibles with four, occasionally three, setae.....*Tenthredo* Linnaeus.

4(1) Mandibles with a single seta; labrum without median longitudinal depression; legs with dorsal aspect of femur usually twice as long as trochanter.....5.

5(6) Body with complexly patterned markings on the dorsum; distal segment of maxillary palpi usually longer than that of labial palpi; head nearly black..*Tenthredopsis* Costa.

6(5) Body without complexly patterned-markings on the dorsum; distal segment of maxillary palpi usually not longer than that of labial palpi; head pale or light brown *Neopus* MacGillivray

Tenthredopsis semilutea Norton.—Body on dorsum with complexly patterned purplish-black markings extending to supraspiracular lines; two lighter colored spots on dorso-meson, their apices directed cephalad, cephalic one much larger than caudal; large spot with caudal emargination on latus and contiguous to mesal triangles; subspiracular lobe with faint, minute spots; otherwise ventral half of body including legs and larvapods whitish; head purplish black excepting the following parts, which are white: genae including antennae and antennariae, lower fourth of front, vertex narrowly, laterad of vertical portion of epicranial arms, clypeus, labrum, and mouth-parts except tips of mandibles, which are black;

fronto-clypeal suture sometimes black; in young specimens, head grayish and body entirely whitish-green; in life head and body coated with a waxy bloom; annulation, (3, 5, 1), (2, 4), 6, 7; antennae, 5, 2, (1, 3, 4); maxillary palpi, (4, 2), 3, 1; labial palpi with distal segment twice as long as the preceding segment, but subequal in length to or shorter than distal segment of maxillary palpi; labrum usually with three setae on each side and without median longitudinal depression; mandible with one seta; legs with trochanter one-half as long as tibia, femur slightly longer than tibia; glandubae half as long as adjacent setae; length, 18 mm.; width of head, 1.8 mm.; on *Thalictrum polygamum;* Y-8,-92-1-1.

Neopus 14-punctatus Norton.—Head pale creamy-white with brown spots on dorso-meson of vertex, caudad of ocellarae, and on front, frontal spots much darker; body whitish green, dorsum with a grayish shade, bordered along supraspiracular lines with narrow grayish bands, dorso-meson, especially on thorax, with fine double bands; venter including legs and larvapods whitish; annulation, (1, 5, 3), (2, 4, 6, 7); antennae, (5, 1), 2, (3, 1); maxillary palpi, 4, 2, (3, 1); labial palpi with distal segment one-fourth longer than preceding segment, but subequal to distal segment of maxillary palpi; labrum with three setae on each side, median longitudinal depression wanting; mandible with single seta; legs with trochanter nearly one-half as long as femur, tibia equal in length to femur; glandubae more than half the length of adjacent setae; length of body, 18 mm.; width of head, 1.8 mm.; on *Podophyllum peltatum:* Y-205-1-1.

Tenthredo bilineata MacGillivray.—Head whitish green with vertex brown dorsad of genae except narrow line along epicranial stem, vertical furrows, and caudad and dorsad of ocularia; body on dorsum with series of triangular brownish markings; triangle with apex directed cephalad and with minute deep brown spot at each basal angle, the triangle divided on meson by a faint light line; supraspiracular line with light brownish indefinite band; venter including legs and larvapods whitish; annulation, (3, 1, 5), (7, 6, 2, 4); antennae, 5, (1, 2, 3, 4); maxillary palpi, (4, 2), 1, 3; labial palpi with distal segment nearly twice as long as the preceding segment and shorter than distal segment of maxillary palpi; labrum with five setae on each side and with median longitudinal depression; mandibles with four setae; legs with trochanter nearly as long as femur, tibia longer than femur; glandubae conical, large, subequal in length to adjacent setae; length of body, 21 mm.; width of head, 2 mm.; on *Geranium maculatum:* Y-175-2.

Macrophya Dahlbom

Body usually whitish green, on dorsum with or without grayish band, latus sometimes with small black spots; head usually marked on vertex; antennae with segment 1 or 2 longest or all segments subequal in length;

maxillary palpi usually with segments 2 and 4 subequal in length; mandible with two setae; labrum with three setae on each side, with median longitudinal depression; trochanter distinctly shorter than femur; head and body in life usually coated with a thin whitish waxy bloom; dorsal vessel usually showing thru cuticle as a dark fine line; setae microscopic; glandubae shorter or longer than adjacent setae; length, 16-21 mm.

SPECIES OF MACROPHYA

1(4) Head pale brown, with or without a minute brown spot at the caudal end of epicranial stem; body on dorsum with light or pale grayish band, darker along supraspiracular lines, band sometimes obsolete; venter whitish, including legs and larvapods; tenth abdominal segments unmarked; labial palpi with distal segment twice as long as the preceding segment; glandubae very small, shorter than adjacent setae; setae microscopic; head and body coated with thin waxy bloom; on *Prunus serotina;* subgregarious.....2.

2(3) Larger species, length, 20 mm.; width of head, 1.8 mm.; annulation, (1, 5), 3, (4, 6, 7), 2; antennae, (2, 1), (3, 4, 5); maxillary palpi, 2, (1, 3, 4); Y-126,-126-3-C-1..... *flicta* MacGillivray.

3(2) Smaller species, length, 16 mm.; width of head, 1.8 mm.; annulation, (5, 1, 3), 4, 6, 2, 7; antennae, 2, (5, 1, 4), 3; maxillary palpi, (2, 4), (3, 1); Y-59-3-1,-59-4-1..... *fistula* MacGillivray.

4(1) Head with a large blackish spot on dorsal part of vertex, often with black spots caudad of ocellarae; body with or without distinct grayish dorsal band, on latus with rows of black or yellowish spots; venter usually whitish; pedal line sometimes with fine gray markings.....5.

5(8) Body entirely whitish; head on vertex usually with a dorsal spot not expanding distad; without spots caudad of ocellarae.....6.

6(7) Body with a row of small black spots along supraspiracular lines, two spots to each segment, cephalic spot larger than caudal; tenth abdominal tergum unmarked; annulation, (1, 3, 5) (4, 7), (6, 2); antennae, (4, 1), 2, 3; legs with femur more than twice as long as trochanter, tibia shorter than femur, coxa with grayish marking; glandubae longer than adjacent setae; length of body, 22 mm.; width of head, 2.3 mm.; on Sambucus; Y-8.11,-11..... *tibiator* Norton.

7(6) Body without a row of small black spots along supraspiracular lines, but with yellowish spots on latus instead, which are obsolete in alcoholic specimens; annulation, (3, 5, 1), (2, 7, 4, 6); antennae, 1, (2, 3, 4, 5); maxillary palpi, (4, 2), (1, 3); labial palpi with distal segment only one-fourth longer than the preceding segments; legs with trochanter slightly shorter than tibia, femur slightly longer than tibia; length of body, 22 m.; width of head, 2.2 mm.; on *Sambucus racemosa;* Y-8.11 -2(?)-3..... *epinota* Say.

8(5) Body not entirely whitish, dorsum with dark dorsal band; latus with one or more rows of distinct black spots; head on vertex with a dorsal spot expanding distad, broadly T-shaped, caudad of ocellarae with spots; tenth abdominal segment with a minute black spot on caudo-meson; venter lighter in color.....9.

9(10) Body on latus with grayish band darker in color than dorsal band and with only one row of distinct black spots; supraspiracular lines with a row of distinct spots; dorso-lateral lines with a row of smaller, inconspicuous spots; subspiracular line with very faint grayish spots, nearly obsolete; pedal lines with grayish linear markings; annulation, 1, (3, 5), (7, 2, 4), 6; antennae, (1, 2, 3, 4, 5); maxillary palpi, (2. 4), 1, 3; labial palpi with distal segment not quite twice as long as the preceding segment;

legs with femur twice as long as trochanter and slightly longer than tibia; length of body, 19 mm.; width of head, 2 mm.; on *Aster prenanthoides;* Y-8, 81(?)..... *lineata* Norton.

10(9) Body on latus with grayish band lighter in color than grayish-purple dorsal band and with three rows of distinct black spots; dorso-lateral and supraspiracular lines with rows of small spots, two spots to each segment, with caudal spot much smaller and sometimes nearly obsolete; spots on supraspiracular line largest; pedal line with a row of spots, two to each segment, with cephalic spots smaller than caudal; head with black spots on vertex large, sometimes coalesced, covering entire vertex except genae and vertical furrows; front with faint gray spot; annulation, (3, 5, 1), (7, 2, 4, 6); antennae, 2, (1, 5), (3, 4); maxillary palpi, (4, 2), (1, 3); labial palpi with distal segment not quite twice as long as the preceding segment; legs with trochanter more than one-half as long as tibia, femur equal in length to tibia; length of body, 21.5 mm.; width of head, 2.1 mm.; on *Solidago juncea* and *Rudbeckia laciniata;* Y-160-2, -160-1..... *pulchella* Klug.

Subfamily Cimbicinae

Body cylindrical (Fig. 14), tapering uniformly caudad, apparently glabrous, prothorax narrowed; segmentation indistinct; annulation fine, 7, (2, 3, 4), (1, 5, 6), annulets 2, 4, and 7 microscopically setiferous; thoracic legs normal in form, with five segments, femur slightly longer than tibia; larvapods on abdominal segments 2-8 and 10, divided into two unequal lobes on the distal surface, few setae on the dorso-caudal aspect, and none on the cephalic aspect as viewed from side; tenth abdominal tergum without suranal protuberances; suranal and subanal lobes with several short setae; head large, rather thickly setiferous, normal in form; labrum subdivided by diverging depression into median lobe and two lateral lobes, sometimes asymmetrical; antennae with a single segment, button-like but chitinized; ventral glands wanting; glandubae microscopic or minute and stalked, sometimes distinct conical tubercles; spiracles distinctly winged; conspicuous spiracular glands located dorsad of each spiracle of abdominal segments 2-8; cuticle microscopically and densely spinulate or verrucose; mouth-parts normal in form, maxillary and labial palpi rather slender, galea very thick, curved mesad at distal end, sericos large, distinctly chitinized, pear-shaped, U-shaped, or V-shaped; stipes with a distinct triangular projection on the dorsal or cephalic margin; body covered with waxy bloom in life; larvae ejecting yellowish fluid from spiracular glands when disturbed; free leaf-feeders, sometimes semigregarious.

The Cimbicinae is a small compact subfamily consisting of few genera and a limited number of species in the Nearctic region. Systematists are in accord in the general conception of the group, but Konow includes the Perginae in his subfamily Cimbicini. *Cimbex americana*, with its several varieties, is a well-known representative of this subfamily.

GENERA OF CIMBICINAE

1(4) Body in general whitish, without minute colored spots.....2.
2(3) Dorsum of body with a black median stripe.....*Cimbex* Olivier.
3(2) Dorsum of body without a black median stripe.....*Trichiosoma* Leach.
4(1) Body in general not whitish, but with minute colored spots.....*Abia* Leach.

Cimbex Olivier

Larvae very large, distinctly robust, largest of all saw-fly larvae, 40–50 mm. in length; body whitish with a distinct dorso-mesal black line; labrum distinctly asymmetrical, dextral portion larger than sinistral, median cephalic or ventral emargination distinct and deep; body with distinct minute warts or conical glandubae, cuticle microscopically verrucose; spiracular glands semicircular; sericos of labium pear-shaped with its narrow neck directed dorsad or cephalad; lateral lobes small but prominent with several conical tubercles; maxillary palpi, 2, 4, 3, 1; labial palpi, 1, 2; antennae mound-like, wider than high

Cimbex americana Leach.—Length, 50 mm.; head, 5 mm. wide; head white, creamy, microscopically brownish verrucose; black median stripe on dorsum extending from prothorax to the middle of eighth abdominal segment; conical tubercles or glandubae on sublateral lobes larger than elsewhere and 4-7 in number; larvae solitary; on willow, elm, poplar, maple, alder, linden, etc.; Y-68, -8, -182, M-99.

Trichiosoma Leach

Larvae very large, somewhat slender, entirely white; labrum slightly asymmetrical, right side larger than sinistral, median ventral emargination deep, but not reaching the median lobe; body not warty; glandubae microscopic, stalked, arising from very low swellings; cuticle microscopically verrucose; spiracular glands semicircular; sericos of labium U-shaped, narrower on dorsal or cephalic end; lateral lobes not prominent, without conical tubercles; maxillary palpi 2, 4, 3, 1; labial palpi, 1, 2; antennae conical, longer than wide.

Trichiosoma sp.—Length, 38 mm.; width of head, 4 mm.; head creamy white, body whitish; solitary; on willow, poplar, alder, wild cherry; M-78, -44.

Abia Leach

Larvae large, rather plump, greenish or grayish green with minute yellowish or blackish spots; labrum symmetrical, median ventral emargination only slightly indicated, broad; body without warts or tubercles; cuticle microscopically and densely spinulate; glandubae stalked and minute, not arising from swellings; spiracular glands semicircular; sericos of labium V-shaped, widest at dorsal or cephalic end; sublateral lobes

inconspicuous, with several glandubae; maxillary palpi, (4, 2) 3, 1; labial palpi with segments subequal; antennae conical, usually as wide as long.

SPECIES OF ABIA

1(2) Body with a broad dorso-mesal yellowish stripe between subdorsal lines; dorsum above supraspiracular lines shaded brownish gray; head brownish gray except front, genae, clypeus, and labrum which are lighter; ocellarae white; body dorsad of supraspiracular lines shaded grayish or brownish, venter pale whitish-green; dorsum between subdorsal lines yellowish white; body with four rows of minute black spots; middorsal row with a large spot on annulet 7 and a smaller spot on annulets 2 and 4; subdorsal row with a large spot on annulet 7, with a bright yellow spot between two black spots mentioned above; supraspiracular row with a spot on annulets 2 and 4 and a very small spot on annulet 7; subspiracular row with a spot at the ventral ends of annulets 3 and 4; a yellow spot caudad of each spiracle; length, 26 mm.; width of head, 2.7 mm.; on honeysuckle; semigregarious; Y-8.13..... *americana* Cresson.

2(1) Body with a broad dorso-mesal yellowish stripe between subdorsal lines; dorsum above supraspiracular lines not shaded brownish-gray, but body generally greenish. . 3.

3(4) Pedal line without distinct more or less continuous smoky brownish gray band; black spots directly ventrad of spiracles never present; second annulet without minute but distinct spots dorsad of lateral large spots; head grayish brown except front, genae, and clypeus, labrum lighter; ocellarae white; body entirely grayish green, dorsum between subdorsal lines concolorous with other parts, the dorso-meson with a narrow yellowish line; five rows of minute black spots: meso-dorsal row with a larger spot on annulet 7 and a smaller spot on annulets 2 and 4; subdorsal row with a larger spot on annulet 7 and very minute and often obscure spot on annulet 2, and larger, distinct, often subdivided, spot on annulet 4, the latter two nearer to meson than the regular subdorsal spots; lateral row with a large spot between annulets 2 and 3; supraspiracular row with a smaller spot on annulets 4 and 7; subspiracular with a larger spot at the ventral end of annulets 3 and 4; a bright yellow spot between mesal and subdorsal black spots on annulet 7; length, 28 mm.; width of head, 2.8 mm.; on *Triosteum aurantiacum;* Y-8.13-2, M-196..... *inflata* Norton.

4(3) Pedal line with distinct, more or less continuous smoky brownish gray band; black spots directly ventrad of spiracles always present, at least on majority of segments; one or two minute black spots on second annulet dorsad of large lateral spots always present; length, 30 mm.; width of head, 2.9 mm.; on honeysuckle; Y-104, G-583, both from Urbana, Ill.; larvae resemble *A. inflata* in markings and general appearance but differ as above..... *Abia* sp. 1.

SUBFAMILY HOPLOCAMPINAE

Larvae (Fig. 15) small; body cylindrical, slender; segmentation and annulation sometimes obsolete; third abdominal segment with four or five annulets, annulets 2 and 3 or 2 and 4 setiferous or all annulets glabrous; larvapods present on abdominal segments 2-7 and 10, glabrous or setiferous, sometimes very rudimentary; ventral glands usually present on the meson of abdominal segments 1-7; body greenish or yellowish, striped or spotted or without any markings; tenth abdominal tergum with or without suranal protuberances, if present, often more than two in number; antennae

conical, with five segments, or flattened, with four, sometimes apparently with three; larvae free leaf-feeders and borers in fruits or petioles of leaves.

The Hoplocampinae as defined by MacGillivray contains at present five genera, Marlattia, Hoplocampa, MacGillivrayella, Hemichroa, and Craterocercus, and represents, together with Dineurinae, a series in which the anal veins have been modified before the loss of the radial cross-vein. Formerly Rohwer (1910, 1911a, 1913b) considered Hoplocampa and MacGillivrayella as constituting a subfamily Hoplocampinae but later (1918c) he abandoned this idea and united these genera with six other genera and subgenera to form the tribe Hemichroini of his subfamily Nematinae, as others have done. With the exception of two genera, Platycampus and Anoplonyx, Rohwer's tribe Hemichroini becomes coextensive with our Hoplocampinae. Cameron (1883) considered this subfamily as forming "a connecting link between the Selandrides and Nematides." There are reasons for indicating a close relation between this subfamily and Nematinae. A study of the larvae confirms the contention of Rohwer (1918c) that the grouping of Caliroa and Phyllotoma with the Hoplocampinae, as was done by Konow and Enslin, is untenable.

It must be stated here that since only three genera, each represented by a single species, were available for this study, the preceding definition of the subfamily is necessarily incomplete.

GENERA OF HOPLOCAMPINAE

1(2) Tenth abdominal tergum without caudal protuberances.....*Marlattia* Ashmead.
2(1) Tenth abdominal tergum with caudal protuberances.....3.
3(4) Caudal protuberances more than two in number; larvapods well developed; third abdominal segment with five annulets; free leaf-feeders.....*Hemichroa* Stephens.
4(3) Caudal protuberances two in number on caudal projection; larvapods rudimentary; third abdominal segment with four annulets; leaf-petiole borer. *Caulocampus* Rohwer.

Hemichroa Stephens

Larvae small, greenish; length less than 18 mm.; body slender, tapering uniformly caudad; third abdominal segment with five annulets 2 and 4 setiferous; tenth abdominal tergum with several conical caudal protuberances on its caudal margin; antennae distinctly conical, with five segments, as long as the longest diameter of antennaria; antennal segment 1 crescentic, dorsal in position, extending nearly the entire length of antennaria, segment 2 complete or incomplete, reduced to mere line on cephalic aspect, segments 3 and 4 ring-like tho reduced in length on cephalic portion, segment 5 conical or peg-like, bluntly pointed at apex; thoracic legs with tibia subequal in length to femur; larvapods glabrous; spiracles faintly winged; glandubae distinct and large; larvae free leaf-feeders.

Hemichroa dyari Rohwer.—Larvae yellowish green; length, 16 mm.; head blackish; body with blackish dorso-lateral lines and interrupted

blackish lines on subspiracular and pedal lines; tenth abdominal tergum with six to seven conical protuberances, suffused with brown; surpedal and subspiracular lobes with two setae and two glandubae; glandubae with diameter twice that of anal setae; annulation, (1, 2, 4) 3, 5; on alder; Y-39--1-1,-8.73 (?) -1,-8.73(?)-2, C-8.

Marlattia Ashmead

Larvae comparatively very small, greenish, with or without stripes or spots; body cylindrical, tapering caudad; third abdominal segment with five annulets, annulets apparently glabrous; tenth abdominal segment without caudal protuberances; antennae with four segments, flattened; segment 1 small, incomplete; segments 2 and 3 complete but reduced to narrow line on cephalic aspect; segment 4 minute, mamma-like; head sparsely setiferous, setae increasing in length on the lower portion; thoracic legs normal in form, tibia subequal in length to femur; larvapods with a few setae; spiracles minute, unwinged; glandubae microscopic.

Marlattia laricis Marlatt.—Head pale yellowish, body greenish with faint subdorsal lines; third abdominal segment with five annulets, (1, 2) 4, 3, 5; larvapods with three setae; suranal lobe with a few setae on caudoventral aspect; small larvae, length, 10 mm.; M-57.

Caulocampus Rohwer

Larvae very small; length less than 10 mm.; body subcylindrical, tapering at prothorax, constricted suddenly on the ultimate segment, not spotted or striped, but whitish, sparsely and microscopically setiferous; third abdominal segment with four annulets, annulets 2 and 3 with very minute setae; thoracic legs minute, with five segments, tibia longer than femur; abdominal segments 2-7 with rudimentary larvapods represented by spinulate swellings; tenth abdominal tergum much smaller in diameter than preceding segments, strongly converging caudad, caudal margin produced and chitinized, a pair of minute brownish caudal protuberances on the caudal margin of the projection; head small, sparsely and minutely setiferous; ocellarae represented by pigmented spots, distinct, ring-like, ocularia wanting; antennae apparently with three segments, conical, segments 1 and 2 incomplete, segment 3 slender, peg-like; mouth-parts normal and conspicuous tho small; spiracles not winged; glandubae obsolete; in young specimens dorsum of abdominal segments 1-7, with a pair of protuberances on annulet 2; larvae borers in leaf-petiole.

This genus is monotypic and unique in the reduction of larvapods and ocellarae and in the possession of modified caudal projection on the ultimate segment with rudimentary caudal protuberances. In this last

character the larvae of this genus resemble those of certain species of Pontania. The modifications of the body are undoubtedly correlated with the boring habit of the larvae. MacGillivray still considers this genus as without question belonging to the Cladiinae, but Rohwer regards it as belonging to his tribe Hemichroini. It is dealt with here under the Hoplocampinae because the larvae more closely resemble larvae of this subfamily than they do those of the Cladiinae.

Caulocampus acericaulis MacGillivray.—Length, 8 mm.; width of head, .8 mm.; head light brown, body straw-yellow; resembles larvae of weevils in general appearance; mouth-parts normal in form; in young specimens head yellowish and body whitish; annulation, 2, 1, 3, 4; maxillary palpi, 3, 2, 1, 4, segments brown, slender; galea digit-like, very small; thoracic legs with very small tibiae, tibia subequal in length to maxillary palpus; tenth abdominal tergum with many minute setae evenly and promiscuously scattered, not concentrated on subanal lobe; larvae bore into the petioles of maple-leaves; Y (generosity of Dr. W. E. Britton, New Haven, Conn.).

Subfamily Dineurinae

Larvae small; body subcylindrical, flattened on venter or cylindrical, usually tapering toward the caudal end, greenish or yellowish, often with dorsum darker, never with bright-colored markings; glabrous or setiferous; head small, light greenish or yellowish, never with distinct markings; ocellarae blackish; mouth-parts usually brownish; thorax wider than the remainder of body, thoracic legs well-developed, caudal pairs larger than the cephalic, directed laterad; segmentation distinct; annulation indistinct; larvapods on abdominal segments 2-7 and 10, sometimes rudimentary; intersegmental coria often distinct and whitish; larvae feed on under side or upper side of leaves, eating the parenchymatous layers only or feeding on edges of leaves or mining in the leaves; ultimate stage glabrous and yellowish; pupation in single-layered parchment-like cocoons in the ground; some species with nauseating odor.

The Dineurinae as limited by MacGillivray contains three genera, Dineura, Mesoneura, and Pseudodineura, and includes not over twenty-five species, which are mostly distributed in Europe and North America. This subfamily resembles in wing-type the Hoplocampinae. Systematists do not agree in the exact position of the small European genus Pseudodineura. Konow would place Dineura in his tribe Nematides but both Mesoneura and Pseudodineura in his tribe Blennocampides. Rohwer, on the other hand, would associate Dineura and Mesoneura in his tribe Nematini, and is not quite certain whether Pseudodineura also belongs to this tribe or not. Cameron, who described the larva of *Pseudodineura parvulus* under the name of *Dineura despecta*, altho aware of the differences

between this species and its allies and other species of Dineura, hesitated to agree with Thompson in associating it with Blennocampa. The venation certainly indicates close relationship between Dineura and Pseudodineura. The latter is characterized in its larval stages by the leaf-mining habit and structural modifications due to this mode of life, altho apparently these do not constitute very striking distinctions if one may judge from published records. Since previous authors failed to study the structures of the head more carefully, and since these are of great taxonomic importance, and also on account of the discrepancy between the larval habits of the three genera in question, it is impossible to pass judgment on their affinity until more is known with regard to their larval structures and habits, particularly in the case of Pseudondineura.

The life history of the subfamily has been recorded by Girard, Cameron, and Brischke and Zaddach. The larvae of the American species are unknown, and as none of the European species have been available for study the definition of the Dineurinae here given is tentative, and is based on descriptions and figures published by Cameron (1882) and by Brischke and Zaddach (1883).

Subfamily Cladiinae

Larvae (Fig. 16) of small to medium size; body rather flattened, wider than high, slightly tapering caudad, conspicuously hairy, greenish or with segmentally arranged spots on dorsum darkly shaded; segmentation and annulation usually distinct; third abdominal segment with four annulets, annulets 1, 2, and 3 setiferous, setae, especially on annulets 2 and 3, arising from wart-like tubercles, long, often curved, always microscopically barbed, never branched, some of the setae distinctly longer than others; annulet 4 narrow and glabrous; larvapods present on abdominal segments 2-7 and 10 well developed, long, distal portion often dilated, appearing as if subdivided, often curved mesad, always with few setae; ventral glands small but always present on abdominal segments 1-7; tenth abdominal tergum without caudal protuberances but with many setae of varying length; thoracic legs spreading flat laterad; femur with a ventro-distal projection, subequal in length to tibia; antennae with four segments, subconical, large; segment 1 complete or incomplete, segment 2 complete, thicker, dorsal or caudo-dorsal portion with clear spaces, segment 3 smaller and narrower than segment 2, segment 4 minute, conical; spiracles never winged; glandubae small or obsolete; sericos usually very wide, occupying nearly four-fifths of the width of the totaglossa; larvae external leaf-feeders.

The Cladiinae is a small subfamily and according to MacGillivray consists of six genera; Anoplonyx, Platycampus, Priophorus, Cladius, and Trichiocampus. The first three genera are placed in the tribe Hemichroini of his subfamily Nematinae by Rohwer (1911, 1918), who states that

"the characters of both the adult and the larva point out subfamily difference between Caulocampus and Priophorus" and that the former superficially resembles Hoplocampa in all stages but is really related to Craterocerus. The difference of opinion is due to the different value placed by these two writers on the presence or absence of the radial cross-vein in differentiating the subfamilies. The genus Caulocampus has been discussed in connection with the Hoplocampinae because the larvae of this genus are very different from those of the Cladiinae both morphologically and biologically and because they are more naturally associated with the larvae of the Hoplocampinae. Anoplonyx is represented in the Neartic region by a single species. Platycampus includes four American species, two of which have been recognized in the immature stages. *P. americana* feeds on Populus and *P. juniperi* on juniper. None of these larvae have been examined.

GENERA OF CLADIINAE

1(2) Body spotted, with a row of blackish or brownish spots on subdorsal, supraspiracular or subspiracular lines; setae usually recurved exceedingly long, longest ones longer than one-half the height of the head; annulet 1 usually with one seta on each side of meson.....*Trichiocampus* Hartig.

2(1) Body never spotted; setae usually straight, long, but the longest ones never distinctly longer than half the height of the head; annulet 1 always with more than one seta on each side of meson, usually with four to six setae.....3.

3(4) Head with spots, usually with blackish patches on dorso-meson of vertex and caudad of each ocellara; body dorsad of spiracular lines usually shaded darker than the venter; body sometimes pinkish; postsupraspiracular tubercles usually with three setae, never with more than four.....*Priophorus* Dahlbom.

4(3) Head never with spots, usually uniformly greenish; body dorsad of spiracular lines never shaded darker but concolorous with venter; body never pinkish but greenish yellow or whitish; postsupraspiracular tubercles usually with six setae, never with less than four.....*Cladius* Rossi.

Trichiocampus Hartig

Larvae small to moderately large, length from 10 to 25 mm., distinctly hairy, with segmentally arranged spots; body with a longitudinal row of blackish or brownish spots along subdorsal, supraspiracular, or subspiracular lines; annulet 4 shortest, annulet 1 usually with one and sometimes two setae on each half of body, annulet 2 with tubercles bearing 2-5 setae, annulet 3 with three warts, two dorsal ones bearing 4-5 setae and ventral one with 6-9 setae, postspiracular tubercle usually with two setae, subspiracular lobe with 8-9 setae, surpedal lobe with 6-10 setae; setae usually recurved, variable in length, longest setae nearly subequal in length to the height of head; warts or tubercles with setae of varying length, those on annulet 1 among the shortest.

SPECIES OF TRICHIOCAMPUS

1(2) Body with three pairs of longitudinal rows of blackish or brownish segmentally arranged spots along subdorsal, supraspiracular, and subspiracular lines; tenth abdominal tergum not entirely black but white except a pair of minute spots; head light brown with brownish spots, with following parts dark brown: dorso-meson of vertex, dorsal two-thirds of front, and vertex dorso-caudad of each ocellara including gena; preclypeus whitish, other parts pale, including occiput between vertical furrows; a row of brownish spots from mesothoracic to ultimate segment along each side of dorso-meson; a row of larger spots along supraspiracular line from prothoracic to penultimate segments; another row of much smaller spots along subspiracular lines from mesothoracic to eighth abdominal segment; mesothoracic and metathoracic subspiracular spots more than twice as large as supraspiracular spots of same segments; the former with circular white areas around the proximal end of setae; prothoracic supraspiracular spots small and indistinct; third abdominal segment with following setal map: 1, 3, 5, 1, 2, 5, 4, 8, 9-10, 8-9; tenth abdominal tergum white, except a pair of minute spots; subdorsal spots not involving tubercles 2 and 3; supraspiracular spot involving tubercles 4 and 5; subspiracular spot on caudal half of subspiracular tubercle; maxillary palpi (2, 3), 1, 4; head in younger specimens blackish except near the mouth; body without spots; in older specimens, supraspiracular spots appear first, then subspiracular, beginning with caudal segments, setae on tubercles sometimes one or two less than in mature specimens; on Populus; length of body, 12 mm.; width of head, 1.5-1.6 mm.; G-Onekama and Orono on oak, length of body, 13 mm.; width of head, 1.7 mm., M-207. (The latter resembles the former so closely and indistinguishably, altho its setae may be slightly fewer in number, that they are considered as identical.).....*paetulus* MacGillivray.

2(1) Body with two pairs of longitudinal rows of blackish or brownish segmentally arranged spots along supraspiracular and subspiracular lines; tenth abdominal tergum entirely black; head blackish, with paler areas.....3.

3(4) Mesothoracic supraspiracular spots subequal in size to subspiracular spots; supraspiracular spots of abdominal segments not involving postsupraspiracular tubercles; prothoracic supraspiracular spots minute and indistinct; preclypeus, labrum, and genae blackish; metathoracic subspiracular spots with minute but distinct circular whitish areas around proximal end of setae; head blackish, paler along vertical furrows, epicranial arms, and postclypeus; body with a row of blackish spots from mesothoracic to penultimate segment along supraspiracular and subspiracular lines; tenth abdominal tergum black; third abdominal segment with the following setal map: 1, 3, 3, 0, 2, 4, 4, 5-6, 8-9, 6-8; subspiracular spot involving few setae directly ventrad of spiracles; head in younger specimens entirely blackish and spots on subspiracular lines wanting; maxillary palpi, (2, 3), 1, 4; length of body, 18 mm.; width of head, 1.3 mm.; on Salix; Y-151-1-1,-151-1-3; M-100,-261. (The specimens in the Maine collection are practically identical with my specimens except in the number of setae on subspiracular and surpedal lobes, which may exceed the number given by one or two).....*patchiae* MacGillivray.

4(3) Mesothoracic supraspiracular spots not subequal to but distinctly larger, twice or more, than subspiracular spots; supraspiracular spots of abdominal segments involving postsupraspiracular tubercles; prothoracic supraspiracular spots large and distinct; preclypeus, labrum, and genae not blackish but pale brown; metathoracic subspiracular spots without minute but distinct whitish circular areas around the proximal end of setae; head black, paler along vertical furrows, epicranial arms, clypeus, labrum, and genae; body with a row of blackish or brownish spots from prothorax to penultimate segment along supraspiracular and subspiracular lines:

tenth abdominal tergum black; third abdominal segment with the following setal map: 2, 2, 3, 1, 2, 4, 4-5, 7-8, 8-9, 9-10; mesothoracic supraspiracular spot more than twice as large as subspiracular spot; prothoracic supraspiracular spots moderately large and distinct; subspiracular spot involving few setae in caudal portion of subspiracular tubercle; mesothoracic and metathoracic subspiracular spots without circular whitish areas around the proximal end of setae; maxillary palpi usually 3, 2, 1, 4; head in young specimens pale brownish, with a row of very small supraspiracular spots; head in older larvae blackish, body spotted like mature specimens but spots smaller; on Populus; length of body, 21-23 mm.; width of head, 2-2.1 mm.; Y-172-1-1.
Trichiocampus sp. 1.

Priophorus Dahlbom

Larvae small, hairy; length less than 17 mm.; body with dorsal half, at least in part, usually with grayish or olivaceous shade; never with spots; annulet 1 with a transverse row of several setae; annulet 2 with two warts, each bearing 4-5 setae; annulet 3 with three warts, dorsal two bearing 5-6 setae each, ventral with 8-10 setae; postsupraspiracular wart usually with three setae; subspiracular lobe with 12-15 setae and surpedal lobe with 6-9; setae usually more or less straight, usually of two different lengths, longer ones usually less than one-half the height of the head; warts bearing setae of two varying lengths, those on annulet 4 being among the shortest setae.

SPECIES OF PRIOPHORUS

1(2) Front with a distinct blackish or fuscous spot; vertex with a dorso-mesal fuscous spot occupying nearly the entire space between vertical furrows; body never pinkish but whitish; head caudad of ocellarae fuscous; body dorsad of spiracular lines from mesothorax to penultimate segment olivaceous or grayish, color becoming dilute on caudal segments; third abdominal segment with following setal map: 4-5, 4, 5, 1, 3, 6, 8, 12, 13, 8-9; maxillary palpi 2, (3, 4), 1; in younger specimens dorsal grayish shade confined to cephalic segments; on hazel; length, 15 mm.; width of head, 1.5 mm.; M-109.
modestius MacGillivray.

2(1) Front without a distinct blackish or fuscous spot, but with a light or pale brown spot; vertex with a dorso-mesal fuscous or blackish spot, not nearly occupying the entire space between vertical furrows; body sometimes pinkish; not on hazel.....3.

3(4) Head brown; vertex with blackish spot occupying about one-half the distance between vertical furrows; body pinkish; head with blackish spot caudad of ocellarae; dorsum of mesothorax to first abdominal segment shaded gray, prothorax whitish; third abdominal segment with the following setal map: 5, 4, 4, 1, 3, 5, 5, 10, 10-12, 6-2; maxillary palpi, 2, (3, 4), 1; in younger specimens body whitish; length, 14 mm.; width of head, 1.2 mm.; on Salix; Y-154-1-2.....*palliolatus* MacGillivray.*

4(3) Head pale brown; vertex on dorso-meson with blackish spot occupying two-thirds the distance between vertical furrows; spot also caudad of ocellarae; body not pinkish but whitish, dorsad of spiracular lines from mesothorax to penultimate

*This species was described as *Trichiocampus palliolatus* n. sp. by Dr. MacGillivray in the Entomological News, vol. XXXII, 1921, page 49, but the characters of the larva place it in the genus Priophorus. Upon reexamination of the adult specimens, Dr. MacGillivray agrees with me in the change I here make.

segment distinctly and uniformly olivaceous-gray; third abdominal segment with following setal map: 5-6, 5, 5, 1-2, 3, 6, 6, 10, 15, 8-9; maxillary palpi, 2, 3, (4, 1); in younger specimens black spots on head larger and olivaceous shade on dorsum of body restricted to cephalic segments; length, 16 mm.; width of head, 1.6 mm.; on *Prunus virginicus;* Y-138-3. (This species resembles *P. solitaris* according to Dyar's description but the latter feeds on Alnus,.....*Priophorus* sp. 1.

Cladius Rossi

Larvae rather small; length less than 15 mm.; body slightly flattened, greenish or yellowish green; never with spots or shaded on dorsal half; annulet 1 with a transverse row of several setae, annulet 2 with two warts bearing 5-6 setae, annulet 3 with three warts, dorsal two bearing 6-7 setae, ventral with 10 setae; postsupraspiracular tubercles with 5-6 setae; subspiracular lobe with 14-17 setae, surpedal lobe with 10 setae; setae usually straight, usually of two lengths, longer ones less than half the height of head; setae on annulet 1 among the shortest.

Cladius pectinicornis Fourcroy.—Length, 12-14 mm.; head pale brownish or yellowish, microscopically verrucose, with brownish spots; front touched with light brown; body hairy, uniformly greenish or greenish yellow; third abdominal segment with the following setal map: 5-6, 5, 6, 1, 5-6, 6, 7, 10, 14-17, 10; maxillary palpi, (2, 3), 1, 4; on Rosa; Y-3, M-244.

Subfamily Nematinae

Larvae (Fig. 18) small to moderately large; body cylindrical, slender, or abdomen increasing in diameter; segmentation and annulation usually distinct; third abdominal segment with 4, 5 or 6 annulets, annulets 1, 2, 3, or 1, 2, 4, or more usually 2 and 4, setiferous; larvapods present on abdominal segments 2-7 and 10, setiferous or sometimes glabrous; ventral glands present on the meson of abdominal segments 1-7; thoracic legs normal in form; body uniformly greenish or darker colored, striped or spotted, tuberculate, setiferous or smooth; antennae with four segments, conical, subconical, limpet-shaped, or flattened; antennal segments sometimes incomplete or in part fused together; tenth abdominal tergum with or without a pair of caudal protuberances; glandubae sometimes distinct, conspicuous, and stalked; spiracles winged or not; larvae free leaf-feeders, gall-makers, and leaf-rollers.

The Nematinae is a large subfamily of several genera and numerous species and is characterized by the coalescence of the cells 2d A and 3d A due to the atrophy of the free part of the 3d anal vein. The absence of the radial cross-vein and the cell 1st 2d A distinguishes the adults of this subfamily from those of the Hoplocampinae and Cladiinae respectively. Rohwer (1912), who would unite the Nematinae, Hoplocampinae, and three genera of the Cladiinae in one subfamily, Nematinae, states that the

subfamily contains two types of larvae and that most of the aberrant larvae belong to his tribe Hemichroini. It may be pointed out that the Nematinae as defined by MacGillivray also contains two types of larvae, which are separable on the presence or absence of the caudal protuberances on the ultimate segment. There are, however, other morphological and biological characters of the larvae which suggest that this subfamily contains a number of genera of wide diversity, and that such genera as Pteronidea and Pontania might profitably be subdivided into more genera.

GENERA OF NEMATINAE

1(18) Tenth abdominal tergum without caudal protuberances.....2.

2(11) Antennae conical or subconical, antennal segments 2 and 3 always complete, segment 4 peg-like or conical, at least as long as wide at proximal end; third abdominal segment always with six annulets.....3.

3(4) Annulets 2 and 4 glabrous; larvapods glabrous; glandubae obsolete; thoracic legs with coxae in part always colored brownish.....*Nematus* Panzer.

4(3) Annulets 2 and 4 not glabrous; larvapods usually not glabrous; glandubae usually not obsolete; thoracic legs with coxae usually in part not colored.....5.

5(6) Antennae with segment 3 ring-like, its cephalic portion subequal in length to caudal portion, segment 2 complete, its cephalic portion not reduced to a mere line; body increasing in diameter to abdominal segments 5-6; spiracles usually winged; larvapods glabrous or with 2-4 or more setae as viewed from lateral aspect.....
Pristiphora Latreille.

6(5) Antennae with segment 3 not ring-like, its cephalic portion not subequal in length to caudal portion; segment 2 usually complete but its cephalic portion reduced to a mere line.....7.

7(8) Body increasing in diameter to abdominal segments 5-6, not uniformly cylindrical; spiracles usually winged; larvapods with 4-6 setae as viewed from lateral aspect.
Diphadnus Hartig.

8(7) Body not increasing in diameter to abdominal segments 5-6 but uniformly cylindrical; spiracles never winged; larvapods with 1-2 setae as viewed from lateral aspect.....9.

9(10) Thorax distinctly swollen; head pale brownish green; maxillary palpi with segment 2 as long on its lateral aspect as on its mesal aspect; legs with femur and tibia concolorous with body, whitish; body with dorsum not shaded bluish green.....
Pteronidea Rohwer (in part).

10(9) Thorax never distinctly swollen; head not pale brownish green but blackish; maxillary palpi with segment 2 three times as long on its lateral aspect as on its mesal aspect; legs with femur and tibia not concolorous with body but blackish; body with dorsum shaded bluish green.....*Lygaeonematus* Konow.

11(2) Antennae not conical or subconical, but flattened; antennal segments 2 and 3 not always complete, segment 4 never peg-like or conical, never as long as wide at proximal end; third abdominal segment not always with six annulets.....12.

12(13) Segments with four annulets, annulets 1, 2, and 3 setiferous; gall-makers.....
Pontania Costa (in part).

13(12) Segments with more than four annulets, annulet 1 not setiferous; not gall-makers..14.

14(15) Segments with five annulets, annulets 2 and 3 setiferous; antennae with all segments fused together; larvapods with two setae as viewed from lateral aspect; body-setae very long.....*Micronematus* Konow.

15(14) Segments with five or six annulets, annulets 2 and 4 setiferous; antennae usually not with all segments fused together; larvapods usually with many more than two setae as viewed from lateral aspect; setae on body not very long; glandubae usually conspicuous and stalked.....16.

16(17) Segments with six annulets; larvapods with 7-10 setae as viewed from lateral aspect; surpedal areas at least in part always marked with gray; latus of abdomen never with numerous brownish spots; tenth abdominal tergum sometimes distinctly pointed and produced caudad and with many conspicuous glandubae near the caudal margin; larvae usually feeding on monocotyledonous plants...*Pachynematus* Konow.

17(16) Segments with five annulets; larvapods with 3-5 setae as viewed from lateral aspect; surpedal areas not marked with gray; latus of abdomen sometimes with numerous brownish spots; tenth abdominal tergum never distinctly pointed and produced caudad; larvae usually feeding upon willow.....*Amauronematus* Konow (in part).

18(1) Tenth abdominal tergum with a pair of caudal protuberances.....19.

19(20) Gall-makers and leaf-rollers; segments with four annulets; annulets 1, 2, and 3 setiferous; antenae flattened; body setae more than twice as long as spiracles; caudal protuberances normal in form and position or rudimentary or borne on a small caudo-mesal projection, if normal in form and position, the tergum with paired colored markings.....*Pontania* Costa (in part).

20(19) Free leaf-feeders; segments usually with five or six annulets, if four, annulets 2 and 4 usually setiferous; antennae conical or flattened.....21.

21(22) Antennae conical, segment 2 complete, segment 3 ring-like, its cephalic portion subequal in length to caudal portion; body on latus with eleven conspicuous blackish-brown spots, surpedal and subspiracular areas of abdominal segments 1-9 and venter between larvapods of abdominal segments 2-8 similarly marked; spiracles not winged; caudal protuberances of ultimate segment small, blunt, not longer than wide at proximal end; segments with five or four annulets, with annulets 2 and 3 or 2 and 4 setiferous.....*Croesus* Leach.

22(21) Antennae conical or flattened; if conical, segment 3 not ring-like but reduced in length on cephalic aspect; body not marked as in Croesus; spiracles winged or not winged; caudal protuberances of ultimate segments not blunt, minute, but usually much longer than wide at proximal end.....23.

23(24) Segments apparently with five annulets; annulets 2 and 3 setiferous; antennae flattened, with segment 3 complete; body-setae subequal in length to spiracles; smaller larvae, length, 13-15 mm.....*Amauronematus* Konow (in part).

24(23) Segments with four or six annulets; annulets 2 and 4, rarely 1, 2, and 3, setiferous; antennae conical or flattened, segment 3 complete or incomplete; body-setae often longer than the length of abdominal spiracles; small to moderately large larvae, length, 15-23 mm.....*Pteronidea* Rohwer (in part).

Diphadnus Hartig

Larvae small, greenish; length less than 14 mm.; body cylindrical, increasing in size to abdominal segments 5–6, tapering at each end; thorax not swollen; tenth abdominal tergum without a pair of caudal protuberances; third abdominal segment with six annulets, annulets 2 and 4 setiferous; spiracles distinctly and usually equally winged; head marked with black or brown streaks along epicranial stem and dorsad of ocellarae; somewhat compressed cephalo-caudad; labrum with median emargination broad and deep and with median longitudinal depression; antennae distinctly conical,

with four segments, segment 1 incomplete, segment 2 usually complete tho reduced to a mere line on cephalic part, segment 3 narrowed on cephalic part, segment 4 short, conical, or peg-like; larvapods setiferous, setae 4-6 in number as viewed from lateral aspect; anal larvapods rather large; glandubae sessile; cuticle microscopically spinulate; suranal and subanal lobes with numerous setae; larvae free leaf-feeders.

Diphadnus appendiculatus Hartig.—Length, 13 mm.; width of head, 1.35 mm.; body green, venter glossy white; tenth abdominal tergum not marked; head greenish white with blackish brown streak along epicranial stem, except near the occiput, and continuing to the dorsal two-thirds of front, vertex dorsad of each ocellara not quite reaching the epicranial suture; surface of head with minute brownish spots; following parts brown: mandibles at apices, antennae, cervical sclerites, coxae at proximal third, tarsal claws, and spiracles; setae minute, with conspicuous calices, blackish; glandubae smaller at distal end than the calyx of seta; larvapods on cephalic and lateral aspects with 4-6 setae and with a single ventral glanduba; annulation, 1, (6, 2), (3, 5), 4; subspiracular lobe with 5-6 setae and without glandubae; surpedal lobe with about 4 setae and one subsessile glanduba; on gooseberry; Y-158, -159, M-128.

Pristiphora Latreille

Larvae small, greenish; length less than 15 mm.; body cylindrical usually slightly enlarged at abdominal segments 5-6, tapering at each end; thorax not swollen; tenth abdominal tergum without the paired caudal protuberances; third abdominal tergum with six annulets, annulets 2 and 4 microscopically setiferous, setae sometimes obsolete; annulet 1 always longest and annulet 3 and 4 always shortest; spiracles usually winged, caudal wing usually much smaller than cephalic; head marked usually with a blackish or brownish streak along epicranial stem, surface with minute brown spots; labrum with distinct mesal emargination and longitudinal depression; antennae conical or limpet-shaped, usually with four distinct segments, segment 1 always minute, incomplete on caudal side, segment 2 complete, but usually narrower on cephalic side, segment 3 uniform in length, segment 4 short, conical; larvapods usually glabrous and with a single ventral glanduba, if setiferous, setae microscopic, 2-4 in number as viewed from side; anal larvapods rather conspicuous, glandubae sessile or stalked; cuticle microscopically spinulate, suranal and subanal lobes with numerous setae; tenth abdominal tergum as seen from side notched dorsad of suranal lobe; free leaf-feeders.

SPECIES OF PRISTIPHORA

1(8) Larvapods setiferous; antennae always conical; head always with a brownish streak dorsad of each ocellara; spiracles always with cephalic wing distinctly larger than

caudal wing; setae with calices surrounded by minute brownish areas; glandubae always sessile, sometimes microscopic, diameter never more than half the diameter of calices of setae.....2.

2(3) Glandubae minute but distinct, about one-third as large as calices of setae or microscopic in smaller specimens; annulation, 1, (5, 6), 2, 3, 4; subspiracular area with 3-4 setae; surpedal area with 3-4 setae; larvapods with 2-4 setae as viewed from side; head light brownish-green, marked with fuscous streaks on both sides of entire length of epicranial stem, front with dorsal two-thirds light brown; following parts light brown: labrum, antennae, mandibles, cervical sclerites, tarsal claws, and spircles; body greenish, caudal segments pinkish or bluish, dorsal vessel dark green with distinct fine white line on eash side; Length, 14 mm.; on Salix; Y-143-2-2,-155, M-96. *murtfeldtiae* Marlatt.

3(2) Glandubae microscopic, difficult to detect.....4.

4(5) Second annulet of abdominal segments always longer than either fifth or sixth annulet; larvapods with about two setae as viewed from side; subspiracular areas with 4-5 setae, surpedal areas with 4 setae; annulation, 1, (5, 6), 2, 4, 3; on birch; M-24.....*Pristiphora* sp. 1.

5(4) Second annulet of abdominal segments always shorter than either annulet 5 or 6; larvapods with 1-2 or 2-4 setae as viewed from side; subspiracular areas with four setae; on alder or willow.....6.

6(7) Larvapods with 1-2 setae as viewed from side; annulation 1, 2, (4, 5, 6), 3; surpedal areas with 3-5 setae; body green, cylindrical; head pale brownish-green, marked with brown streak along entire length of epicranial stem and dorsal two-thirds of front and vertex, narrowly dorsad of each ocellara; following parts brown: antennae, labrum, mandibles, maxillary palpi, cervical sclerites, tarsal claws, and spiracles; antennae conical, segment 4 short, conical; spiracle with cephalic wing distinctly longer than caudal; setae without brown areas surrounding calices; glandubae minute, sessile, microscopic; M-74.....*Pristiphora* sp. 2.

7(6) Larvapods with 2-4 setae as viewed from side; surpedal areas with 3-5 setae; annulation, 1, 2, 6, 5, 4, 3; on wolly willow; M-90.....*Pristiphora* sp. 3.

8(1) Larvapods glabrous; antennae conical or limpet-shaped; head with or without a dark streak dorsad of each ocellara; spiracles winged or not winged, if winged, wings subequal in size, or cephalic wings larger than caudal; setae usually with calices surrounded by minute but distinct brownish areas; glandubae sessile or stalked, sometimes microscopic.....9.

9(10) Head distinctly and uniformly brownish; spiracles indistinctly winged; all setae ventrad of subdorsal lines with calices surrounded by minute brownish areas; antennae conical; glandubae subequal to calices in diameter; annulation, 1, 5, 6, 2, 3, 4; on birch; M-132.....*Pristiphora* sp. 4.

10(9) Head never distinctly and uniformly brownish.....11.

11(12) Body on dorso-meson from prothorax to fifth abdominal segment with a distinct blackish line; spiracles winged, cephalic wings usually larger than caudal; all setae ventrad of subdorsal lines with calices surrounded by minute brownish areas; antennae conical; glandubae minute, about half as large as calices in diameter; head with distinct line along epicranial stem; vertex without a dark streak dorsad of each ocellara; annulation, 1, 2, (5, 3, 4, 6) or 1, 2, (3, 4, 5, 6); on Prunus; M-128..... *Pristiphora* sp. 5.

12(11) Body on dorso-meson from prothorax to fifth abdominal segment without a distinct blackish line.....13.

13(14) Head entirely pale or light brown; vertex without dark streak along epicranial stem, antennae distinctly conical; spiracles winged, wings subequal in size; setae never with

calices surrounded by distinct brownish areas; glandubae probably obsolete, microscopic; annulation, 1, 5, 6, 2, 3, 4; on oak; M-20.....*Pristiphora* sp. 6.

14(13) Head never entirely pale or light brown; vertex always with a dark streak along epicranial stem, sometimes indistinct but never entirely wanting.....15.

15(22) Spiracles winged; setae ventrad of spiracular lines with calices surrounded by distinct minute brownish areas; antennae always conical; vertex with or without a dark streak dorsad of each ocellara.....16.

16(19) Spiracles with cephalic wings always larger than caudal; glandubae always sessile; glandos microscopic, difficult to detect; setae on latus dorsad of spiracular lines with calices surrounded or not surrounded by distinct brownish areas.....17.

17(18) All setae on latus dorsad of spiracular lines with calices surrounded by brownish areas; vertex dorsad of each ocellara with a brownish streak; annulation, 1, (5, 6), 2, 4, 3; body green; head marked as in *P. bivittata;* length of body, 12-13 mm.; on Salix; M-72.....*sychophanta* Walsh.

18(17) All setae on latus dorsad of spiracular lines with calices not surrounded by brownish areas; vertex dorsad of each ocellara without a brownish streak, uniformly pale; annulation, 1, (2, 5, 6), 4, 3; body enlarged on abdominal segments 5-6, greenish, with dorsal vessel dark green with white line on each side; head greenish with brownish streaks along entire length of epicranial stem, expanding on the dorsal half of front; following parts brown: labrum, mandibles, antennae, cervical sclerites, tarsal claws, and spiracles; antennae conical, segment 4 elongate, conical; on *Spiraea latifolia* and *S. tomentosa;* M-4.....*Pristiphora* sp. 7.

19(16) Spiracles with wings subequal in size; glandubae stalked; glandos subequal in diameter to calices; setae on latus dorsad of spiracular lines never with calices surrounded by distinct brownish areas.....20.

20(21) Vertex with a distinct dark streak dorsad of each ocellara; annulation, 1, 2, (5, 6), 4, 3; length, 16-17 mm.; body cylindrical, increasing in size to abdominal segments 5-6, green, dorsal vessel dark green with fine white line on each side of it; head green, slightly brownish, with fuscous streaks; following parts light brown: dorsal two-thirds of front, labrum, maxillary palpi and galea, labial palpi, and cervical sclerites; following parts brown: antennae, mandibles, spiracles, glandubae, and setae; antennae conical, distinctly with four setae, segment 4 conical; spiracles with wings; ventral glands subequal in size to larvapods; glandos in diameter subequal to or larger than calices of setae; setae on dorsum very minute; on Spirea; Y, M-14,-88.....*bivittata* Norton.

21(20) Vertex without a distinct dark streak dorsad of each ocellara; annulation, 1, 2, 6, 5, 3, 4; on Potentilla; M-10.....*Pristophora* sp. 8.

22(15) Spiracles not winged; setae ventrad of spiracular lines never with calices surrounded by distinct minute brownish areas; antennae limpet-shaped, segments indistinguishably fused; vertex always with a brown streak dorsad of each ocellara; glandubae sessile; glandos microscopic, difficult to detect; annulation, 1, (2, 5, 6), (3, 4); length 12-13 mm.; body green, with broad dark green dorsal vessel bordered on each side by a fine white line; head greenish brown; setae stiff, comparatively long, without brown areas surrounding calices; on *Geum canadensis;* Y-212..*Pristiphora* sp. 9.

Micronematus Konow

Larvae small; length less than 15 mm.; body subcylindrical, tapering at both ends; mesothorax distinctly and metathorax slightly swollen; lateral lobes prominent and swollen; segmentation distinct; annulation indistinct; third abdominal segment with five annulets, annulets 2 and

3 setiferous; thoracic legs spreading laterad, normal in form; larvapods setiferous, normal in form, except the anal pair, which is reduced in size, only one-half as large as the other pairs; tenth abdominal tergum without the paired caudal protuberances; head circular, smaller than thorax in width and height, front flattened; antennae apparently with four segments, flattened, all segments fused together; ventral glands very large; setae sparse, very long; spiracles not winged; suranal and subanal lobes multisetiferous; glandubae subsessile; free leaf-feeders.

Konow in 1905 listed three species of Micronematus: *abbreviatus*, *californicus*, and *monogyniae*. The second species properly belongs to Diphadnus. Of the two remaining species, *M. abbreviatus* was recognized in the larval stages a long time ago by Snellen von Vollenhoven (1868). This genus is European and is represented in North America by a single species, *Micronematus gregarius* Marlatt. That this species does not belong to Pachynematus can be readily seen from the structure and biological characters of the larvae as was suggested by Dyar (1897) in his original description of the immature stages. Three facts distinguish this species from all other known species of Pachynematus: (1) the larva has five annulets instead of six; (2) the anal larvapods are very much reduced in size; and (3) the larva feeds on willow instead of grasses. On the other hand *M. gregarius* has certain characters in common with *M. abbreviatus* as recorded by Vollenhoven. Since this species can not be referred to Pachynematus or to any other known American genus, and since it has characters which are peculiar to Micronematus, and since the adult characters, according to Ashmead (1898), would place it in this genus, this species is here considered as belonging to Micronematus. If future study should prove this position untenable, a new genus should be erected.

Micronematus gregarious Marlatt.—Length, 12 mm.; body shiny, yellowish white; alimentary canal showing thru as green tube; head pale testaceous with a broad blackish band across the front between ocellarae and a narrow band dorsad of each ocellara to and along vertical furrow; mouth-parts, cervical sclerites, and legs except coriae brownish; abdominal segments 1-8 with postspiracular and subspiracular areas swollen, mound-like, and tinted fuscous; abdominal segments 2-7 with colored postspiracular areas larger than subspiracular areas; those on segments 1 and 8 much smaller; thoracic segments with two colored patches on latus, one larger and more ventral than the other; larvapods with about two setae on the cephalo-lateral aspect; ventral glands nearly three times as large as larvapods; setae slender, at least twice as long as spiracles; spiracles not winged; subspiracular area with two setae and single glanduba, surpedal area with 3-4 setae and single glanduba; larvae gregarious; on Salix; Y.

Lygaeonematus Konow

Larvae comparatively speaking moderately large, length 18–20 mm.; body cylindrical, tapering uniformly and slightly caudad; thorax not swollen; abdomen never swollen; dorsum grayish green and venter pale, head shiny black, only slightly narrower than thorax; antennae conical, with four distinct segments, segment 1 minute, incomplete, and with single sensory pit, segments 2 and 3 narrower on cephalic part than on caudal part, segment 4 conical; labrum with mesal emargination shallow and broad; maxillae with galea larger than labial palpi; maxillary palpi with segment 2 three times as long on lateral margin as on mesal; third abdominal segment with six annulets, annulet 1 largest, annulets 2 and 4 setiferous; larvapods well developed, setiferous, with 1-2 setae and single ventral glanduba; glandubae sessile; glandos smaller than calyx of a seta; ventral glands subequal to or larger than larvapods in size; spiracles not winged; tenth abdominal tergum as seen in profile not notched dorsad of suranal lobe and without caudal paired protuberances; setae usually arising from minute fleshy mound-like protuberances; cuticle microscopically spinulate; free leaf-feeders.

Lygaeonematus erichsoni Hartig.—Length, 18-20 mm.; body somewhat shiny, greenish gray dorsad of spiracular lines, ventrad of them opaque bluish-white, head black; following parts fuscous to blackish: mouth-parts, cervical sclerites, femur, tibia, and claws; following parts grayish: surpedal areas, coxa, and trochanter in part, swellings between legs, and abdominal surpedal areas faintly; annulation, 1, 2, 6, (3, 5, 4); glandos half as large in diameter as calices of adjacent setae; surpedal areas on abdomen with 8-10 setae and two glandubae; subspiracular area with 6-7 setae, usually without glandubae; cuticle with distinct microscopic brownish spinulae; on larch; Y-162, M-105, -165.

Pachynematus Konow

Larvae comparatively speaking moderately large; length, 15–23 mm.; body cylindrical, tapering uniformly and distinctly caudad; thorax rarely and abdomen never swollen; third abdominal segment with six annulets, annulets 2 and 4 setiferous, annulet 1 longest, annulet 4 usually shortest; tenth abdominal tergum without a pair of caudal protuberance, and without a notch dorsad of suranal lobe as seen in profile; the tergum sometimes produced distinctly caudad and pointed; suranal and subanal lobes with numerous setae; head brownish or greenish, sometimes with fuscous streak along epicranial stem, semiglobose, subequal in width to thorax or only slightly narrower; labrum with median longitudinal depression, cephalic emargination shallow; maxillae with galea always larger than labial palpi, sometimes more than twice as large; antennae with four segments, flattened, never distinctly conical, segment 1 usually minute, in-

complete, segments 2 and 3 with cephalic parts distincty reduced to mere lines, sometimes all four segments fused; larvapods always setiferous, with 8-11 setae on cephalic and lateral aspects and a single ventral glanduba; glandubae conspicuous, cylindro-conical, at least twice as long as wide at proximal end; spiracles usually not winged, if winged, rather indistinctly; setae stiff, brown, arising from fleshy mound-like minute tubercles; in younger specimens third abdominal segment with five annulets, annulets 1, 2, and 3 with stiff brown setae; glandubae obsolete; cuticle microscopically spinulate; larvae usually feed upon grasses.

This generic description is based upon two identified and several unidentified species. The known species can be separated as follows:

SPECIES OF PACHYNEMATUS

Head with narrow fuscous or blackish streak along epicranial stem and vertical furrows; tenth abdominal tergum with a broad fuscous streak on the meson and the caudal margin produced distinctly caudad and bluntly pointed, with many conspicuous glandubae; antennae with four fused segments; annulation, (2, 1), 6, (3, 4, 5); larvapods with 7-9 setae on cephalic and 1 seta on lateral aspect; subspiracular lobe with 5-6 setae and 1-2 glandubae; surpedal lobe with 5-7 setae and 1-3 glandubae; body on dorso-lateral lines with narrow, interrupted longitudinal fuscous, bands; head as wide as thorax; length, 20 mm. width of head, 2 mm.; on Carex; Y-150.....*subalbatus* Norton.

Head with narrow fuscous or blackish streak along epicranial stem and vertical furrows; tenth abdominal tergum without a broad fuscous streak on the meson, the caudal margin only slightly produced caudad, rounded, with many glandubae; antennae with four segments not fused; annulation, (1, 2), 6, (3, 4, 5); larvapods with about ten setae on cephalic and one seta on lateral aspect; subspiracular lobe with about six setae and a single glanduba; surpedal lobe with six setae and three glandubae; head as wide as thorax; length, 16 mm.; width of head, 1.6 mm.; on Carex; Y-177.....*repertus* MacGillivray.

NEMATUS PANZER

Larvae comparatively small, length about 10 mm.; body cylindrical, uniform in diameter thruout the entire length excepting the caudal end, where it is tapering, dull green, apparently glabrous; annulation indistinct; third abdominal segment with six annulets, annulets glabrous, formula: 1, 5, 2, 6, 3, 4; thoracic legs normal in form; coxa usually fuscous on proximal half; larvapods small, diminishing in size gradually on the caudal segments, not setiferous; ventral glands subequal in size to larvapods; tenth abdominal tergum without a pair of caudal protuberances, with a notch dorsad of suranal lobe as seen in profile, caudal margin truncate or slightly emarginate on the meson, not produced; suranal lobe with several minute setae on ventral aspect; subanal lobe with moderately numerous minute setae; abdomen with lateral lobes inconspicuously swollen; head circular in outline, rounded in profile on dorsal half, front flattened; ventral half of head with several longer and larger setae; dorsal half nearly glabrous or with microscopic setae; vertex usually with a fuscous

streak caudad and dorsad of each ocellara; antennae four-segmented, subconical or sublimpet-shaped, sometimes in part fused; segment 1 minute, segments 2 and 3 reduced to mere line on cephalic aspect, segment 4 minute, subconical; mouth-parts and cervical sclerites fuscous to blackish; maxillary palpi with two distal segments distinctly smaller than segment 2, which is sometimes longer than all the other segments taken together; galea larger than labial palpus; sericos distinct, circular; subspiracular and surpedal lobes with a few microscopic setae; glandubae probably microscopic, usually obsolete; spiracles usually winged; cuticle microscopically spinulate; free leaf-feeders.

SPECIES OF NEMATUS

1(4) Vertex with a fuscous streak caudad and dorsad of each ocellara; maxillary palpi with segment 2 shorter than all the other segments taken together.....2.

2(3) Vertex with fuscous streaks extending dorsad of vertical furrows; antennae with all segments fused and almost completely filling antafossae; spiracles distinctly winged; tenth abdominal tergum with caudal margin shallowly emarginate on the meson; head with dorsal half entirely glabrous; length, 11 mm.; on oak; M-21. . *chloreus* Norton.

3(2) Vertex with fuscous streaks not extending dorsad of vertical furrows; antennae with all segments distinct, but not nearly completely filling antafossae; spiracles not distinctly winged; tenth abdominal tergum with caudal margin not emarginate on the meson; head with dorsal half sparsely setiferous; length, 9 mm.; Y-133. *Nematus* sp. 1.

4(1) Vertex without a fuscous streak caudad and dorsad of each ocellara; maxillary palpi with segment 2 slightly longer than all the other segments taken together; antennae with four distinct segments; spiracles winged; length, 10.5 mm.; on oak; M-2. *Nematus* sp. 2

Croesus Leach

Larvae moderately large, length about 25 mm., body cylindrical tapering caudad on abdominal segments 7-10 and also at cephalic end of prothorax; segmentation distinct; annulation indistinct; third abdominal segment with four or five annulets, annulets 2 and 3 setiferous; tenth abdominal tergum with a pair of low, conical, bluntly rounded caudal protuberances, usually as wide as or wider than high; head flattened on front, rounded, shiny black; antennae distinctly conical with four segments: segment 1 incomplete, three times as long as wide, segments 2 and 3 usually complete and not reduced to mere lines on the cephalic aspect, segment 4 peg-like, bluntly pointed, longer than wide at proximal end; maxillary palpi with segment 1, 3, and 4 subequal in length, segment 2 twice as long as segment 1; larvapods setiferous; spiracles not winged, indistinctly colored; glandubae subsessile or with a short stalk, very wide in diameter more than three times the diameter of shaft of setae; maxacoria developed into a distinct triangular swelling dorso-caudad of cardo, and covered with dark spinulae.

Croesus latitarsus Norton.—Length, 25 mm.; annulation, 3, 2, 1, 4 or 2, 1, 5, 3, 4; larvapods with 4-5 setae and a single glanduba as viewed from side, no markings; tenth abdominal tergum with dark-colored area

contiguous to concolorous suranal protuberances; suranal and subanal lobes with numerous setae, which increase in length with the distance from the anus; body yellowish green or brownish, with colored patches on subspiracular and surpedal areas and on subdorsal line from mesothorax to ninth abdominal segment; abdominal segments 2-8 on ventro-meson each with a large colored patch; in younger stages body fuscous with few distinctly delimited colored patches or none; M-1,-26,-50,-51,-48.

Amauronematus Konow

Larvae small to moderately large; length 15-20 mm.; body cylindrical, often tapering distinctly caudad; latus with subspiracular and surpedal areas colored or with numerous, minute colored spots; head blackish, brownish, or greenish; third abdominal segment with five annulets, annulets 2 and 3 or 2 and 4 setiferous; tenth abdominal tergum with or without caudal paired protuberances; body setae much longer or shorter than the length of spiracles; larvapods with 2-3 or 3-5 setae as viewed from side; spiracles not winged; larvae free leaf-feeders.

The larval stages of five species of Amauronematus have been described by Dyar. Of these, larvae of *luteotergum*, *dyari*, *oregonensis*, and *similis* have not been available for study, but according to Dyar's descriptions, the last three apparently lack the caudal paired protuberances. I have a large number of larvae collected on willow by Dr. MacGillivray which also lack the paired caudal protuberances and probably belong to this genus. The species may be separated as follows:

SPECIES OF AMAURONEMATUS

1(4) Tenth abdominal segment with paired caudal protuberances.....2.

2(3) Abdomen on ventro-meson with a row of blackish spots; caudal paired protuberances and head blackish; gregarious; on alder.....*luteotergum* Norton.

3(2) Abdomen on ventro-meson without a row of blackish spots; paired caudal protuberances and head not blackish but pale; solitary; on Azalea.....*azaleae* Marlatt.

4(1) Tenth abdominal segment without paired caudal protuberances.....5.

5(6) Mature and also younger larvae with antennae flattened and their segments fused in part, with no discernible or with very small antacoria; younger larvae (14 mm. or less) with annulets 1, 2 and 4 setiferous; annulets 2 and 4 with transverse row of warty protuberances each bearing 2 or 3 stiff stout setae; older larvae (14 mm. or more) without numerous brownish spots on dorsum and latus and without brownish interrupted and diffuse dorso-mesal and dorso-lateral lines; on sweet fern; M-85. *Amauronematus* sp. 1.

6(5) Mature larvae with antennae whose segments are all distinctly separated by distinct antacoria; young larvae with antennae like those of preceding species; younger larvae (14 mm. or less) with annulets 1, 2, and 4 setiferous; annulets 2 and 4 without transverse row of warty protuberances the setae being minute and arranged singly; older larvae (14 mm. or more) with numerous brownish spots on dorsum and latus with brownish, interrupted, and diffuse dorso-mesal and dorso-lateral lines; on willow; M-10.....*virendus* MacGillivray.

Another species, resembling the preceding very closely and, difficult to distinguish except by the colored spots which are more or less darker and slightly more numerous than in *virendus*: M-112.....*vescus* MacGillivray.

Pteronidea Rohwer

Larvae small to moderately large; length 15-25 mm.; greenish, often spotted or banded transversely or longitudinally; body cylindrical, slender, uniformly tapering caudad, thorax rarely conspicuously swollen; head and trunk setiferous, often tuberculate; head blackish, brownish, or greenish; antennae with four segments, sometimes with segments in part fused, conical, subconical, or flattened; third abdominal segment with 4-6 annulets, more commonly 5-6, annulets 2 and 4, rarely 1, 2, and 3 setiferous; tenth abdominal tergum with or without a pair of small but distinct suranal caudal protuberances, if without, body swollen on thorax, protuberances pointed, bluntly rounded, truncate, or swollen at distal end; larvapods setiferous, setae few in number; spiracles winged or unwinged; glandubae subsessile or obsolete; leaf-feeders, sometimes gregarious.

The genus Pteronidea is rich in number of species. The author has examined a large number of specimens representing at least thirty species and including much bred material, and has prepared the following synoptic key for differentiating species. It may be stated here that Pteronidea, together with a few allied genera, is readily separated from all other Tenthredinidae by the presence of a pair of suranal caudal protuberances on the lateral portion of the caudal margin of the ultimate tergum. *Pteronidea thoracica* Harrington is unique in lacking the caudal paired protuberances, but is easily distinguished by its characteristic, somewhat elongate, tadpole-like body, and also by its white head and body and its spreading legs. The color and coloration and the presence of setiferous tubercles and their arrangement are useful characters in separating species.

SPECIES OF PTERONIDEA

1(2) Tenth abdominal tergum without suranal processes; thorax conspicuously swollen; thoracic legs spreading out flat laterad; body entirely greenish white; on *Prunus virginiana*; Y-141.....*thoracica* Harrington.

2(1) Tenth abdominal tergum with suranal processes; thorax not conspicuously swollen. 3.

3(50) Head black or brown; body usually with numerous colored patches.....4.

4(5) Body entirely blackish with distinct yellowish spots on latus; on Salix, *Populus balsamifera*, etc.; Y-8.45, M-104, M-182, Y-5-2.....*ventralis* Say.

5(4) Body not entirely blackish, without distinct yellowish spots on latus.....6.

6(7) Body entirely green; head light brown; suranal processes short, mere swellings; on Ribes sp.; Y-1.....*ribesi* Scopoli (ultimate stage)

7(6) Body not entirely green; suranal processes usually distinctly pointed, more than mere swellings.....8.

8(9) Body yellowish with 11 transverse black markings extending between subdorsal lines across the venter. Young collection 55.....*Pteronidia*, sp. 1.

9(8) Body not yellowish, without 11 transverse blackish markings.....10.

10(17) Body without numerous small tuberculate areas, usually without fine longitudinal series of sub-adjacent patches; thorax, at least, always suffused on dorsum with darker shade.....11.

11(12) Body shiny metallic fuscous; dorsum of all segments grayish brown; tenth abdominal tergum uniformly black; Y-132-2-1 (on *Carpinus caroliniana*), Y-132m-1-2 (on *Morus alba*), Y-193 (on *Alnus rugosa*),.....*erythrogastra* Norton.

12(11) Body not shiny metallic fuscous; dorsum of none of segments grayish-brown; tenth abdominal tergum not uniformly black.....13.

13(14) Abdomen on dorso-meson with a fine longitudinal line; tenth abdominal tergum fuscous on dorso-meson; suranal processes distinctly fuscous; on Alnus; M-114. *Pteronidea* sp. 2.

14(13) Abdomen on dorso-meson without a fine longitudinal line; tenth abdominal tergum not fuscous on dorso-meson; suranal processes not distinctly fuscous.....15.

15(16) Tenth abdominal tergum with a fuscous triangular mark on each side of meson; head more or less uniformly brown; on *Salix rostrata;* Y-169, C-427-45..*Pteronidea* sp. 3.

16(15) Tenth abdominal tergum without a fuscous triangular mark on each side of meson; head not uniformly brown but epicranial stem, vertex dorsad of ocellarae, front in the center, and labrum distinctly darker; on hazel (?); M-153.....*Pteronidea* sp. 4.

17(10) Body with numerous small blackish tuberculate areas; sometimes with fine interrupted longitudinal lines composed of irregular subadjacent colored areas; thorax on dorsum never suffused with darker shade.....18.

18(27) Body on dorso-meson with a fine more or less continuous black line independent of greenish or pale dorsal vessel, line occasionally faint but never entirely obsolete; latus usually with fine more or less continuous longitudinal lines.....19.

19(20) Abdomen on ventro-meson with fuscous spots; larvapods on cephalic surpedal areas never with fuscous spots; on Alnus; M-232.....*Pteronidea* sp. 5.

20(19) Abdomen on ventro-meson never with fuscous spots; larvapods on cephalic surpedal areas often with fuscous spots.....21.

21(24) Antennae with antacoriae distinct, not limited to periphery of antafossae; antennal segment 1 very minute, never more than twice as long as wide; segment 2 usually incomplete, if complete, ventral portion never more than a mere faint line; segment 3 usually complete, cephalic portion reduced to a line.....22.

22(23) Larvapods on cephalic aspect with minute irregular blackish or brownish spots near setae; on Salix; Y-8.48(?)-1.....*Pteronidea* sp. 6.

23(22) Larvapods on cephalic aspect without minute irregular black spots near setae; on Salix spp.; Y-6-1,-6-6,-44-1-1, M-156 (in part), C-140, C-649.....*odoratus* Dyar.

24(21) Antennae with antacoriae indistinct, limited to periphery of antafossae; antennal segment 1 complete, or if incomplete, never less than twice as long as wide; segments 2 and 3 always complete, their cephalic and dorsal portions never reduced to mere lines; segment 4 cylindro-conical; all four segments often fused together in part and filling antafossae almost completely; larvapods on cephalic aspect with irregular black spots near setae, spots sometimes very minute but never wanting from all larvapods.....25.

25(26) Antennae with all 4 segments fused together in part and filling antafossae almost completely; on Salix spp.; Y-95-1-1, Y-8.45 (?)s-1-1.....*cornelli* Marlatt.

26(25) Antennae without all 4 segments fused together in part; segment 1 always distinctly separated from the other segments; antacorriae always distinct; on Populus; M-156 (in part).....*Pteronidea* sp. 7.

27(18) Body on dorso-meson never with a fine more or less continuous black line independent of greenish or pale dorsal vessel; latus usually without fine more or less continuous longitudinal lines.....28.

28(29) Latus with distinct more or less continuous longitudinal lines; venter on meson without black spots; C-713.....*Pteronidea* sp. 8.

29(28) Latus without distinct more or less continuous longitudinal lines; venter on meson usually with black spots.....30.

30(31) Larvapods always with black spots on cephalic aspect; dorsum with setiferous black tubercles more or less uniform in size; abdomen on ventro-meson without black spots; on Ribes sp.; Y-1; M-135.....*ribesi* Scopoli.

31(30) Larvapods never with black spots on cephalic aspect; dorsum with setiferous black tubercles never uniform in size; abdomen usually with black spots on ventro-meson.32.

32(33) Larvapods on abdominal segments 4-7 usually with minute black spots on mesal aspect, those on sixth abdominal segment never wanting; abdomen on ventro-meson without black spots; on Salix; Y-95-1; M-155 (in part); M-140.....*Pteronidea* sp. 9.

33(32) Larvapods on abdominal segments 4-7 without minute black spots on mesal aspect; abdomen on ventro-meson with black spots.....34.

34(47) Abdominal segments 7-9 on ventro-meson with black spots.....35.

35(40) Ninth abdominal tergum with colored patches on first three annulets, 4, 6, and 4 patches respectively.....36.

36(39) Dorsum not shaded grayish-brown.....37.

37(38) On Populus; G-14; M-158.....*effeta* MacGillivray.

38(37) On hazel; M-110.....*effusa* MacGillivray.

39(36) Dorsum shaded grayish-brown; on Salix; Y-8.45(?)-2-1.....*Pteronidea* sp. 10.

40(35) Ninth abdominal tergum with colored patches on first three annulets.....41.

41(44) Colored patches on first three annulets 2, 6 and 4 in number respectively.....42.

42(43) Body small, less than 13 mm. in length; Young-49.....*Pteronidea* sp. 11.

43(42) Body large, more than 15 mm. in length; on *Populus balsamifera;* M-182; G-pop. *Pteronidea* sp. 12.

44(41) Colored patches on first three annulets 2, 4, and 4 in number respectively.....45.

45(46) On birch; M-139.....*emerita* MacGillivray.

46(45) On Populus; Y-45.....*lombardae* Marlatt.

47(34) Abdominal segments 2-8 on ventro-meson with black spots.....48.

48(49) Large larvae, 20-23 mm. in length; dorsum without dark shade; head much smaller than thorax in width and height; on Salix; Y-8.45(?)s-5-2. *fulvicrus* Provancher.

49(48) Moderately large larvae, less than 20 mm. in length; dorsum always with dark shade; head comparatively large, only slightly smaller than thorax in width and height; on Salix; M-119.....*evanida* MacGillivray.

50(3) Head not black or brown, usually greenish with few linear markings; body usually without numerous colored patches.....51.

51(54) Body with a pair of distinct fine latero-dorsal lines; larvapods with 1-2 setae as viewed from side.....52.

52(53) Head with a black line extending the entire length of epicranial stem to the occiput; on Salix; M-12.....*crudita* MacGillivray.

53(52) Head without black line extending the entire length of epicranial stem to the occiput; on Salix; M-190.....*Pteronidea* sp. 13.

54(51) Body without a pair of distinct fine dorso-lateral lines; larvapods usually with 3-5 setae as viewed from side.....55.

55(58) Head entirely green.....58.

56(57) Suranal process sharply pointed; on *Rhododendron canadense;* M-46.....*Pteronidea* sp. 14.

57(56) Suranal processes bluntly rounded; on Salix; M-133.....*Pteronidea* sp. 15.

58(55) Head not entirely green, usually with a blackish or brownish line along epicranial stem and one dorsad of each ocellara.....59.
59(64) Suranal process sharply pointed.....60.
60(61) Body tapering caudad uniformly and slightly; uniformly green; on *Salix cordata;* Y-153-1-1,-153-?.....*mendica* Walsh.
61(60) Body not tapering caudad uniformly and slightly; abdomen swollen on segments 5-7; body not uniformly green.....62.
62(63) Latus of each segment with a large fuscous patch; tenth abdominal tergum with caudal margin between suranal processes straight; on Alnus; M-71..... *equina* MacGillivray.
63(62) Latus of each segment without a large fuscous patch; tenth abdominal tergum with caudal margin between suranal processes convex; on birch; M-61. *Pteronidea* sp. 16.
64(59) Suranal processes never sharply pointed but enlarged at distal ends.....65.
65(66) Antennae with segment 3 complete, altho reduced to a mere line on cephalic aspect; on birch; M-60.....*Pteronidea* sp. 17.
66(65) Antennae with segment 3 incomplete; Y-120 (on *Gleditsia triacanthos*); Y-143-1 on *Salix cordata*.....*trilineata* Norton.

Pontania Costa

Larvae comparatively small, whitish or greenish, usually 10-15 mm. in length; gall-makers or leaf-edge-rollers; body cylindrical, thorax usually not swollen; tenth abdominal tergum usually with a pair of suranal protuberances; when the paired caudal protuberances are normal in position, i. e., near the lateral ends of caudal margin of the segment, the tergum usually with paired blackish or brownish markings; caudal protuberances sometimes very minute and borne on the caudal margin of the produced median projection; spiracles winged or not winged; third abdominal segment with four annulets, annulets 1-3 setiferous; head usually dark brown or blackish in younger specimens and yellowish or pale brown in older specimens; labrum with mesal emargination shallow or obsolete; maxillary palpi with segment 2 longest, usually nearly equal in length to segments 3 and 4 taken together; antennae with four segments, segments fused or separate, segments 1 and 2 usuallly incomplete and separate, segment 3 sometimes complete, often fused with segment 4; larvapods setiferous, with four or more setae.

Most Nematinae with gall-making or leaf-folding larvae belong to this genus. The different types of galls are supposed to be specific and are considered of systematic value. Many species are indistinguishable in the immature stages except by the morphology of the galls they produce.

SPECIES OF PONTANIA

1. Gall-Makers

1(18) Tenth abdominal tergum with or without the paired caudal protuberances, if present, small, blunt, usually not longer than wide at proximal end, sometimes borne on caudal projection of suranal lobe; tergum without paired blackish or brownish markings; ninth abdominal tergum with distinct paired markings or transverse rows of minute spots.....2.

2(3) Tenth abdominal tergum without paired caudal protuberances; tibia distinctly longer than femur; head brownish or yellowish with space between ocellarae across the front paler; Y-8-4-1,-8-4-3,-8-6-1, C-y67, M-212; on Salix.....*pomum* Walsh.

3(2) Tenth abdominal tergum with paired caudal protuberances; tibia not distinctly longer than femur.....4.

4(5) Suranal lobe not produced caudad, as a small mesal projection, but with a pair of caudal protuberances, small but normal in position, near the lateral ends of the caudal margin; head blackish or blackish brown, space along epicranial suture paler; spiracles usually not winged; dorsum of segments not transversely marked with gray; on Salix; Y-7-1,-7-4-1,-8.8, C-cu 201, M-92.....*hyalina* Norton.

5(4) Suranal lobe produced caudad, forming a small mesal projection which bears rudimentary paired protuberances; head light brown with front and vertex dorsad of each ocellara darker; spiracles usually winged; dorsum of segments transversely marked with gray; antennae with segments 3 and 4 fused; labrum with mesal emargination obsolete.....6.

6(7) Gall not transected by the leaf, but attached to one surface, point of attachment showing as discolored scar; greater part of gall free from the leaf; two or more galls sometimes adjacent; woolly small-leaved willows; M-148.....*Pontania* sp. 1.

7(6) Gall transecting the leaf; usually only one gall on a leaf.....8.

8(9) Gall involving the midrib; surface of gall irregularly constricted; sometimes 2 or more galls adjacent; M-226.....*devincta* MacGillivray.

9(8) Gall not involving the midrib tho extending to it.....10.

10(15) Long axis of gall parallel to midrib; leaf transecting the gall into two subequal parts.....11.

11(12) Gall kidney-shaped, strongly convex, about 14 mm. in length; M-213. *Pontania* sp. 2.

12(11) Gall not kidney-shaped.....13.

13(14) Gall bean-shaped, slightly convex; 12-14 mm. in length; Y-191-1-1..... *demissa* McGillivray.

14(13) Gall bean-shaped, strongly convex; 14-15 mm. in length; M-262..*Pontania* sp. 3.

15(10) Long axis of gall transverse to midrib.....16.

16(17) Gall transected by leaf into two subequal semiglobose parts, surface not constricted by a furrow; M-211,-216.....*Pontania* sp. 4.

17(16) Gall transected by leaf into two unequal parts; surface constricted by a furrow; M-93.....*Pontania* sp. 5.

2. Leaf-folders

18(1) Tenth abdominal tergum always with the paired caudal protuberances which are sharply pointed, normal in position, and longer than wide at proximal end; tergum usually with paired blackish or brownish markings; ninth abdominal tergum with or without distinct paired markings or transverse rows of minute spots.....19.

19(20) Tenth abdominal tergum without distinct paired blackish or brownish markings; head entirely yellowish; M-150.....*Pontania* sp. 6.

20(19) Tenth abdominal tergum with distinct paired blackish or brownish markings.....21.

21(26) Ninth abdominal tergum without any markings or spots; antennae with segment 3 sometimes incomplete.....22.

22(25) Tenth abdominal tergum with markings extending entire length and dumbbell-shaped; antennae with segments 2 and 3 usually complete.....23.

23(24) Folded portion of leaf irregularly wrinkled; usually both edges folded; M-175. 1-1.....*Pontania* sp. 7.

24(23) Folded portion of leaf not irregularly wrinkled; usually one edge folded; Y-31-1-1, -8, 46(?)-2-2.....*Pontania* sp. 8.

25(22) Tenth abdominal tergum with markings not extending the entire length and not dumbbell-shaped; antennae with segments 2 and 3 incomplete; folded portion of leaf irregularly wrinkled; often both edges folded; Y-139-1-1.....*Pontania* sp. 9.

26(21) Ninth abdominal tergum with some markings or spots; antennae with segment 3 usually complete.....27.

27(32) Ninth abdominal tergum with two transverse rows of minute colored spots.....28.

28(29) Tibia longer than femur; front concolorous with vertex; setae on abdominal terga more than three times as long as spiracles; Y-166-1-1.....*Pontania* sp.10.

29(28) Tibia subequal in length to femur; front not concolorous with vertex but darker; setae on abdominal terga less than three times as long as spiracles.....30.

30(31) Head blackish; mature larvae 9 mm. in length; on Salix; Y-8.46(?)-1-2..... *Pontania* sp. 11.

31(30) Head brownish; mature larvae 11 mm. in length; on Populus; M-166..... *Pontania* sp. 12.

32(27) Ninth abdominal tergum without two transverse rows of minute colored spots....33.

33(34) Ninth abdominal tergum with two pairs of transverse blackish or brownish markings, interrupted on meson; head brownish with area along epicranial suture distinctly clear and paler; Y-142-1.....*derosa* MacGillivray.

34(33) Ninth abdominal tergum with one pair of transverse blackish or brownish markings, interrupted on meson; head blackish or brownish in younger specimens, yellowish or light brown in older specimens with area along epicranial suture not distinctly paler.....35.

35(36) Tenth abdominal tergum with markings not reaching the paired caudal protuberances but broken on caudal half into minute spots; head yellowish with two minute brown spots on front; leaf-edge folder, folded edges not irregularly wrinkled; M-146. *Pontania* sp. 13.

36(35) Tenth abdominal tergum with markings reaching the paired caudal protuberances, not broken on caudal half into minute spots; yellowish or brownish without two minute brown spots on front.....37.

37(42) Ninth abdominal tergum with paired markings on its cephalic half.....38.

38(39) Ninth abdominal tergum with a transverse row of minute spots caudad of paired markings; leaf-edge-folder; both edges often folded and folded portion irregularly wrinkled; M-145.....*Pontania* sp. 14.

39(38) Ninth abdominal tergum without a transverse row of minute spots caudad of paired markings.....40.

40(41) Antennae with segment 3 incomplete; only one edge of leaf-folded, folded portion not irregularly wrinkled; M-89,-147.....*Pontania* sp. 15.

41(40) Antennae with segment 3 complete; both edges of leaf folded, folded portion irregularly wrinkled; M-116,-144.....*Pontania* sp. 16.

42(37) Ninth abdominal tergum with paired markings on caudal half; antennae with segment 3 complete; single edge-folder, folded portion not irregularly wrinkled; Y-8.46(?)-2-2 (in part).....*Pontania* sp. 17.

Nematid genus 1.—Larvae small, greenish; body cylindrical, tapering uniformly toward caudal end; segmentation distinct; annulation indistinct; third abdominal segment apparently with four annulets, annulets 1, 2, and 3 setiferous; thoracic legs conspicuously long, nearly as long as thorax, slender, with trochanter longer than femur; larvapods well developed, setiferous; tenth abdominal segment without the paired caudal protuberances; head circular, front flattened, smaller than thorax in width and

height; antennae with four segments, segments small, incomplete, with large sensory (?) pits, segments sometimes fused in part; spiracles not winged.

This genus is represented by a single unidentified species collected by Chester Young on Salix at Ithaca, New York. The larva is unique in the character of the legs in that the trochanter is longer than the femur. That this species belongs to the Nematinae is unquestionable but it is not closely related to any genus in particular except perhaps to Pontania. It may represent an undescribed genus.

Species 1.—Length, 10.5 mm.; body greenish; head brownish with dorsal half of front dark fuscous; labrum semicircular with slight mesal emargination; maxillary palpi with segment 1 nearly as long as segment 2 which is cylindrical and as wide at distal end as at proximal, segment 3 much smaller, segment 4 minute, peg-like, two distal segments curved mesad; galea conical, only slightly larger than labial palpi; thoracic legs with coxae subequal in length to tibiae, with trochanter slightly shorter than coxa, and as long on dorsal margin as on ventral, femur shorter than trochanter, cylindrical, three-fourths as wide as long, tarsal claws slightly curved; larvapods with 1-2 setae near cephalic aspect; setae slender, not stiff, rather sparse; tenth abdominal tergum rounded on caudal margin, with few setae; subanal lobe with several setae; abdominal segments with subspiracular areas with two setae and surpedal areas with a single setae; on *Salix nigra;* C-c.y.-77.

Subfamily Blennocampinae

Larvae (Figs. 19-20) moderately large; body subcylindrical, sometimes rather robust, tapering uniformly caudad, venter more or less flattened, usually distinctly spinose; segmentation distinct; annulation indistinct; third abdominal segment with five or six annulets, rarely apparently with four; thorax sometimes thickened; thoracic legs well developed, normal, tibia shorter than or subequal to femur; femur produced ventro-distad as pointed membranous projection; larvapods on segments 2-8 and 10, normal in form, glabrous, subsegmented, distal lobe truncate on distal margin and often curved mesad; tenth abdominal segment usually with several spines arranged in a transverse row along caudal margin; suranal and subanal lobes with several setae; head small, sparsely setiferous, narrower than thorax, front slightly convex; antennae with five segments, slender, elongately conical; ventral glands wanting; glandubae sometimes present; spiracles rarely winged; spines often very long, furcate, with two, three, or five branches, barbed, or represented by conical tubercles or sometimes reduced to short bifurcate tubercles; cuticle microscopically and densely spinulate; ultimate stage occurs, in which all setae and spines are lost and

body becomes colorless and glabrous; free leaf-feeders; sometimes gregarious.

The Blennocampinae as restricted by MacGillivray is a large subfamily rich in genera and species, and is related to Fenusinae and Scolioneurinae. This is in agreement with Konow's statement altho this author makes his tribe Blennocampides the third in his subfamily Tenthredinini. Rohwer would group the majority of the genera under consideration in his subfamily Empriinae, but take out the genera Phymatocera and Tomostethus from the subfamily and place them in a subfamily by themselves. This arrangement has an advantage in classifying the larvae because of the fact that the larvae of Tomostethus lack the characteristic spines which readily distinguish the Blennocampinae from all other groups in the larval stages. The following key will separate the genera examined, with two additional ones, Erythraspides and Periclista, whose diagnostic characters are taken from Dyar's paper (1898b).

GENERA OF BLENNOCAMPINAE

1(2) Body without spines; with six annulets, annulets 2 and 4 each with a transverse row of minute but stalked glandubae.....*Tomostethus* Konow.
2(1) Body with spines.....3.
3(10) Third abdominal segment with six distinct annulets; spines usually unbranched but conical, if branched, very short and minute, tenth abdominal tergum with small conical unbranched spines.....4.
4(7) Body spines conical and not bifurcate, blackish.....5.
5(6) Spiracles with distinct black wings.....*Monophadnus* Hartig.
6(5) Spiracles without distinct black wings.....*Hypergyricus* MacGillivray
7(4) Body-spines not conical but bifurcate, blackish or whitish.....8.
8(9) Spines whitish; tenth abdominal tergum not marked.....*Blennocampa* Hartig.
9(8) Spines black; tenth abdominal tergum marked with black..*Erythraspides* Ashmead.
10(3) Third abdominal segment with five annulets, rarely apparently with four; spines in part usually bifurcate, long, never short and conical.....11.
11(12) Tenth abdominal tergum with a mesal spine cephalad of caudal marginal row of spines; subdorsal spines of prothorax with five branches; prothoracic spinal formula: 5-2-1:5:1-2; third abdominal segment:2-2-2:0:3-2-2:2-1:1-2; ultimate tergum 1-1-1: 2:2.....*Monophadnoides* Ashmead.
12(11) Tenth abdominal tergum without a mesal spine cephalad of caudal marginal row of spines; subdorsal spines of prothorax with three branches at most.....13.
13(14) Second annulet of third abdominal segment with three spines dorsad of spiracular line; host-plants not confined to Quercus species; prothoracic spinal formula: 2-2-2: 2-3:1-2; third abdominal segment 2-2-2:1:2-2-2:2-1:1:1.....*Isodictium* Ashmead.
14(13) Second annulet of third abdominal segment with two spines dorsad of spiracular line; host-plants confined to species of Quercus; otherwise resembling the preceding genus.....*Periclista* Konow.

Tomostethus Konow

Larvae moderately large, length 17–21 mm., rather robust, yellowish white; body subcylindrical, tapering little caudad, venter flattened,

without spines, sparsely and microscopically setiferous; head black, shiny, much smaller than thorax; third abdominal segment with six annulets, annulets 2 and 4 each with a transverse row of few stalked glandubae; tenth abdominal segment without spines, truncate on caudal margin; spiracles not winged, but with a pair of faint ventral crescentic brown marks; antennae, (5, 4, 3), 2, 1 in older larvae and 5, (4, 3), 2, 1 in younger larvae; maxillary palpi, 4, 2, 1, 3, pointed; labial palpi rather slender, (1, 2); ultimate stage entirely whitish.

Tomosthethus bardus Say.—Length, 18 mm.; width of head, 1.9 mm.; body whitish with yellowish tinge, in older specimens yellowish white; head shiny black with clypeus alone lighter in color; legs blackish brown; larvae gregarious; on ash; G-2, Y-8.14.

Tomostethus multicinctus Rohwer.—According to Sasscer's description (1911) the larvae of this species are indistinguishable from the preceding species but the bred adults have been assigned to this species by Rohwer. Larvae have not been examined.

Blennocampa Hartig

Larvae rather small, length 15-20 mm.; greenish; body subcylindrical, slender, tapering uniformly caudad; spines small, bifurcate, tubercle-like or conical; head very small, third abdominal segment with six annulets, annulets 2 and 4 spinose; tenth abdominal segment spinose, spines conical, unbranched, numerous, arranged in four rows, 1: 1: 1-1-1: 1-1-1-1-1; typical prothoracic spinal formula: 2-2-1-1-1: 1-1-1: 1: 1-1; third abdominal segment, 2-2-1: 1:2-2-1: 1-1-1: 1-1-1; antennae, 5, (1, 2, 3, 4); maxillaray palpi, (2, 3, 4), 1, slender, pointed; labial palpi (1, 2), nearly equal to two distal segments of maxillary palpi taken together; legs with femur longer than tibia; larvapods normal in form, more or less rounded at distal end.

Blennocampa spiraeae Dyar.—Length, 16.5 mm.; width of head, 1.2 mm.; body greenish; head pale brown; legs concolorous with body; ocellarae entirely black, tips of mandibles and tarsal claws brown; maxillary palpi with segment 4 and labial palpi with segment 2 deep brown; prothoracic formula of spines variable, 2-2-1-1-1 or 2-3-1-1, or 2-1-1-1; abdominal segment on surpedal lobe with from 2-1 to 2-2 spines; tenth abdominal tergum with small, short, conical spines arranged in four rows as follows: (1) two pair of spines on each side of meson, (2) two spines on each side of the meson, near the center of the tergum, (3) lateral pairs sometimes with additional spines, and (4) the last and caudal row of five spines on each side of meson along the caudal margin of tergum, the three lateral spines closer together than the others; on Spiraea; not bred; M-28.

Erythraspides Ashmead

Larvae comparatively speaking small, inconspicuously spinose, greenish; third abdominal segment with five annulets, annulets 2 and 4 each with three minute bifurcate spines.

According to Dyar's Key (1898) the larvae of *Erythraspides pygmaeae* is distinguished from those of *Blennocampa spiraeae* by the black head and spines of the former. Record is meager, and without specimens no adequate diagnosis can be given.

Monophadnus Hartig

Larvae rather small, length less than 15 mm., spotted; body rather robust, only slightly and uniformly tapering caudad; tubercles conical, small, blackish, not furcate; third abdominal segments with six annulets, annulets 2 and 4 tuberculate; tenth abdominal tergum with two rows of tubercles, some of which are bifurcate; prothoracic spinal formula: 1-1:1:1:1; third abdominal segment, 1-1-1:1:1-1-1:1:1; antennae 5, (4, 3, 2), 1; maxillary palpi (4, 2), 1, 3; labial palpi (1, 2); palpi rather thick and conical; spiracles with distinct black wings.

Monophadnus nubilipennis Norton.—Length, 14 mm.; width of head, 1.3 mm.; head blackish brown, clypeus alone lighter; body dirty white with yellowish tinge; legs grayish; on hellebore; Y-42,-8.42.

Hypergyricus MacGillivray

Larvae rather large and robust, spotted; length 16-20 mm., body subcylindrical, tapering but slightly and uniformly caudad; tuberculate, tubercles conical, short, stout, usually not furcate; third abdominal segment with six annulets, annulets 2 and 4 tuberculate; tenth abdominal segment with two rows of few tubercles; prothoracic spinal formula variable, but with a single tubercle on supraspiracular area and two tubercles ventrad of it; third abdominal segment also with variable number of tubercles, only two on subspiracular area; tubercles not furcate; spiracles with faint ventral crescentic brown marks but without definite wings; antennae rather obtusely rounded, segments decreasing in diameter from proximal to distal, but increasing in length; suranal and subanal lobes strongly convex, with numerous short recumbent setae; legs with femur distinctly longer than tibia; distal portion of femur dilated and produced ventro-mesad.

SPECIES OF HYPERGYRICUS

Head black, genae, antennariae, ventral half of front and clypeus lighter in color; tubercles blackish; body whitish, faint grayish shade and yellowish tinge in older stages; legs grayish brown; antennae with segment 3 and 4 subequal in length; prothorax with spines, 2-2:1:1:1; third abdominal segment, 1-1:0:1-1:1:1; latus of body along supraspiracular lines with broken band of grayish shade, marks distinct and square

dorsad of each spiracle; on leaves and fruits of *Smilacina racemosa;* length, 18 mm.; width of head, 1.8 mm.; Y-73,-29-10,-8.73, M-181.....*fumipennis* Norton.

Head brownish yellow; length, 17 mm.; width of head, 1.9 mm.; spots on dorsum variable; body whitish with faint yellowish tinge; legs concolorous with body; supraspiracular lines without smoky-black band; prothoracic spines 1-1-1 or 1-1-1-1:1:1 or 3; third abdominal segment with 1-1; 1:1-1-1:1:1; any of the dorsal tubercles may be wanting; otherwise similar to the preceding species; Y; 20 specimens collected by Mr. J. R. Malloch on Smilacina in Illinois.....*Hypergyricus* sp. 1.

Monophadnoides Ashmead

Larvae small, distinctly spinose, greenish; length less than 17 mm.; body subcylindrical, tapering caudad, rather slender; spines furcate, with two, three, or more branches; third abdominal segment with five, apparently four, annulets, annulets 2 and 3 spinose; prothorax with spines, 5-2-1:(5 or 3):1:2; third abdominal segment, 2-2-2:0:(3 or 2)-2-2:2-1:1-2; tenth abdominal tergum with a mesal furcate spine cephalad of caudal marginal row of spines; legs rather slender, femur slightly longer than tibia, not dilated at distal end; spiracles unwinged; maxillary palpi, (1, 4), (2, 3); labial palpi, (1, 2); maxillary and labial palpi slender, pointed; antennae, 5, (1, 2, 3, 4), sharply pointed and slender; semigregarious.

Monophadnoides rubi Harris.—Length, 16 mm.; width of head, 1.6 mm.; head pale brownish green, distinctly setiferous, spines whitish, branches sometimes light brown; length of longer branches subequal to the width of head as seen in profile; tenth abdominal tergum with mesal spines with 2-3 branches, on the caudal third of the tergum cephalad of the marginal row of spines, sometimes another smaller unbranched spine cephalad of the furcate mesal spines; marginal row of spines, beginning with mesal spine, consists of two simple, one bifurcate and lower, and lateral simple spine on each side of meson; on Rubus and also on giant Ragweed; Y-8.17, M-19,-183, G-562, 500-3.

Isodyctium Ashmead

Larvae rather small, usually distinctly spinose; length less than 17 mm.; body subcylindrical, tapering caudad, rather slender; third abdominal segment with five annulets, annulets 2 and 4 spinose, sometimes apparently four-annulate, with annulets 2 and 3 spinose; spines furcate, usually with two to three branches, branches usually conspicuously long, sometimes small, short, but always sharply pointed at distal end; spiracles never winged; thoracic legs normal, femur subequal in length to or longer than tibia; head blackish or spotted on vertex and front or uniformly greenish; spines on prothorax, 2-2-2-1:2-2:1:2; on third abdominal segment 2-2-2:1:2-2-1:1:1; tenth abdominal segment with a marginal row of spines, usually four on each side of meson.

Several species have been examined. None of the material has been identified altho the following larva may belong to *I. subgregarium.*

Isodyctium sp. 1.—Length, 15.5 mm.; head, 1.5 mm. wide; head marked on vertex and front with large confluent brownish spots, those on front sometimes separate; body uniformly greenish; legs concolorous with body, femur subequal in length to tibia; spines blackish, very long and furcate, with large proximal end, those ventrad of spiracular lines whitish; those one-half as long as head are wide as seen in profile; prothorax with spines, 2-2-2-1:2-2:1:2; third abdominal segment, 2-2-2:1:2-2-2:2-1:1-1; tenth abdominal tergum, 2-1:2:2, the mesal pair sometimes with confluent bases; maxillary palpi, (4, 2), 3, 1; labial palpi, 1, 2; ultimate stage: entirely whitish, vertex pale brown, third abdominal segment with five distinct annulets, setiferous but not spinose; on oak; M-6.

Subfamily Fenusinae

Larvae (Fig. 21) very small; body semicylindrical, venter flattened, depressed, tapering caudad, glabrous; segmentation distinct; annulation indistinct; third abdominal segment with either one or apparently 2-4 annulets; thorax slightly swollen, prothorax sometimes with dorsal and ventral shields; legs small, short, apparently with four segments, spreading cephalo-laterad; larvapods on abdominal segments 2-8, vestigial, merely mound-like; anal larvapods obsolete; tenth abdominal tergum glabrous without suranal processes or caudal protuberances, sometimes with small mesal projections; suranal and subanal lobes glabrous; head sparsely setiferous, depressed, subtriangular in outline, wedge-shaped in profile narrower than thorax and overlapped on caudal third by prothorax; vertical furrows wanting; antennae apparently with single segment; antacoria large; ocellarae minute, located dorso-caudad of antennariae; ventral glands wanting; glandubae wanting; spiracles indistinctly winged; cuticle sometimes with microscopic but distinct chitinized dentiform spines; larvae, leaf-miners.

The Fenusinae is a small subfamily represented by four genera in the Nearctic region. Systematists have always considered this group as closely related to the Scolioneurinae and Blennocampinae. MacGillivray is the only one who would assign them subfamily rank. Konow listed three European species, *dohrni*, *ulmi*, and *pumila*, under the old generic name Kaliosysphinga. The first two are now considered as types of distinct genera. They have been introduced into this country and are liable to do considerable damage at times. The genera studied are separable as follows:

GENERA OF FENUSINAE

Caudal end of body rounded, without a mesal suranal protuberance; sternum of ninth abdominal segment with a pair of swellings covered with distinct microscopic dentiform spines:

tenth sternum strongly convex, much shorter than ninth sternum ..... *Kaliofenusa* MacGillivray.

Caudal end of body truncate, with a mesal suranal protuberance; sternum of ninth abdominal segment flattened, uniformly and microscopically spinulate; tenth sternum slightly convex, nearly as long as the ninth sternum..... *Fenusa* Leach.

Kaliofenusa MacGillivray

Larvae very small, greenish white; length less than 12 mm.; thorax broadest on mesothorax; declivous on dorsum from metathorax toward the head; head only slightly depressed, front convex; mouth-parts normal except labium, which is flattened; mandibles rather thick in profile; dorsum and venter covered with brownish, irregular, microscopic dentiform spines, larger on the center of segment and larvapods; caudal end of body rounded; tenth abdominal tergum without mesal protuberance; sternum of ninth segment with a pair of microscopically dentate swellings; tenth sternum strongly convex, much shorter than ninth sternum.

Kaliofenusa ulmi Sundevall.—Length, 10 mm.; width of head, .9 mm.; head light brown, legs brown, ocularia, mandibles, maxillary palpi, deep brown; sternum of ultimate segment with transverse depression on the caudal third distinct; leaf-miners, on Ulmus, feeding on all tissues except upper and lower epidermis; Y-4-1,-4-2,-8.4.

Fenusa Leach

Larvae very small, length less than 12 mm., greenish white; body rather uniform in width except at caudal end which tapers suddenly and distinctly; head strongly depressed; front flattened; mouth-parts protruding beyond the distal end of mandibles; body uniformly and microscopically spinulate; no distinct localized microscopic dentiform spines; caudal end of body truncate; tenth abdominal tergum with a distinct mesal conical suranal protuberance; sternum of ninth segment rather flattened, without microscopically dentate swellings; tenth sternum slightly convex, nearly as long as ninth.

Fenusa dohrni Tischbein.—Length, 10-11 mm., width of head, 1.1 mm.; head brown; prothorax with dorsal and ventral shields indicated; thoracic legs light brown, trochanter wanting, femur subequal in length to tibia; tibia with proximal end subequal in diameter to distal end of femur; tenth abdominal sternum with transverse depression in caudal fourth indistinct; body often greenish, green adipose tissues being visible thru the cuticle; dorsal vessel showing thru as light-colored line; leaf-miners on *Alnus vulgaris*, feeding habit similar to that of *Kaliofenusa ulmi;* Y-4. A, -43-1-2.

Subfamily Scolioneurinae

Larvae (Fig. 22) very small; body semicylindrical, somewhat depressed, flattened on venter, broader on thorax, tapering caudad, glabrous, greenish, never with bright patterns; segmentation distinct; annulation indistinct, third abdominal segment with two annulets; larvapods rudimentary, mere swellings on abdominal segments 2-7, the anal pair adjacent on meson, forming a single protuberance; thorax thickened, prothorax often with distinct dorsal and ventral chitinized shields; thoracic legs small, slender, distinctly five-segmented, directed laterad; head depressed, subtriangular, wedge-shaped in profile, narrower than thorax; mouth-parts flattened and protruding, labium large, with submentum and mentum strongly chitinized; antenna one-segmented; vertical furrows usually wanting; tenth abdominal tergum abbreviated, glabrous; spiracles usually winged; glandubae obsolete; ventral glands wanting; cuticle often with minute dentiform tubercles; leaf-miners.

The Scolioneurinae is a small subfamily containing six genera, four of which are peculiar to the Nearctic region. All six genera are represented in the North American fauna. Prior to the recognition of the subfamily by MacGillivray, the species belonging to it were referred to the genera Fenusa and Blennocampa. Konow first segregated a species of Entodecta and later more of Scolioneura from Blennocampa, placing them, together with Fenusa and its allies, in other genera of his tribe Blennocampides. Rohwer would separate the genera of the Scolioneurinae from those of the Blennocampinae but unite them with those of the Fenusinae in the tribe Messini of his subfamily Messinae. The close affinity of the Fenusinae and Scolioneurinae is evident from the fact that all known larvae of these subfamilies are leaf-miners and that they possess similar types of structural modifications. The definitions here given are based on observations on two American species of Metallus supplemented by writings of European students—Cameron, Brischke, and Zaddach.

Metallus Forbes

Larvae small, length 10-13 mm., whitish or pale brownish; body depressed, rather stout, mesothorax broadest; pleuron of each segment tuberculate; cuticle with microscopic irregular chitinized dentiform tubercles, those on center of dorsum and venter largest; head directed ventro-cephalad, much narrower than thorax, attached to the ventral part of prothorax; vertical furrows wanting; front twice as long as wide, labrum subtriangu'ar, small; antennae mamma-like; ocellarae inconspicuous, about one-fifth the diameter of the antennaria; mouth-parts small but distinct, slightly modified; mandibular dentes sharp; maxillary palpi three-segmented, stipes elongate, galea digit-like, slightly curved

mesad and subequal in size to palpi, lacinia thin, small, plate-like; labium comparatively large, flattened; labial palpi inconspicuous, apparently 2-segmented; ligula globose and proturding; thoracic legs with coxa large, stump-like, following segments suddenly smaller and slender, trochanter ring-like, femur as long as wide, tibia longer than femur, cylindrical, chitinized, tapering gradually to distal end, tarsal claws broadly curved, sharp; mesothorax and metathorax with a dorsal membranous swelling on each side of the meson; spiracles distinctly and semicircularly winged; tenth abdominal tergum small, convex; anal setae wanting; subanal lobe small, prominently convex.

SPECIES OF METALLUS

Head brownish, not concolorous with body, epicranial suture very distinct; dorsal and ventral shields distinct and brown; dorsal shield transverse, covering dorsum of prothorax, proventral shield very large, occupying entire venter between prothoracic legs caudad of and continuous with brown cervacoria, mesoventral and metaventral shields small, transverse, triangular between legs; labium with submentum strongly chitinized, brown with dark carina on meson and along caudal margin, mentum brown, longer than wide; larvapods with crescentric brownish band on cephalic aspect; length, 11-12 mm.; on Rubus; Y.....*rubi* Forbes.

Head pale or whitish, concolorous with body, at least not distinctly colored; dorsal and ventral shields obsolete, only rarely faintly indicated; labium with submentum broad and without dark median longitudinal carina, depression on meson rarely present, never dark and distinct; larvapods without crescentric brownish band on the cephalic aspect; length, 10 mm.; on Rubus; Y.....*bethunei* MacGillivray.

The larvae of *Metallus rubi* were described by Forbes, but the original specimens are apparently lost. The description given here is based on specimens in the Cornell Collection. Forty-three larvae of *M. bethunei* were examined thru the courtesy of Mr. H. G. Crawford of Guelph, Ontario, Canada.

SUBFAMILY HYLOTOMINAE

Larvae (Fig. 23) moderately large; body semicylindrical, venter flattened, distinctly wider than high, widest on abdominal segments 1-3, tapering caudad, caudal segments only one half the width of widest segments; yellowish green, spotted or not; segmentation distinct; third abdominal segment with three annulets, all setiferous, often tuberculate; thoracic legs large, spreading laterad, apparently six-segmented inclusive of claws; claws sharply curved, large, distinctly separated from fifth segment by suture and with a large pulvillus-like swelling; larvapods setiferous, on abdominal segments 2-6 and with rudimentary 7th pair, or on 2-7 and 10 with rudimentary 8th pair; antennae one-segmented, either conical or button-like, if conical, larvapods on abdominal segments 2-6 and 10; spiracles distinctly winged; glandubae obsolete; tenth abdominal tergum without suranal processes.

The Hylotominae in the adult stage is closely allied to the Schizocerinae. but in the larval stages their affinities, if extant, are not so manifest, The laravae are peculiar in possessing six-segmented thoracic legs and varying numbers of larvapods. The shape and general appearance of the larvae are so characteristic that they alone are sufficiently reliable for identification in the field. Two genera are represented in the Nearctic region, the genus Atomacera, which includes only a few species, has not been studied.

Hylotoma Latreille

Head, conspicuously shiny black, brown or yellowish, or with a brown median streak; body with minute blackish tuberculate setiferous spots forming interrupted longitudinal rows along some or all of the subdorsal, latero-dorsal, supraspiracular, subspiracular, and pedal lines; annulation usually 2, 3, 1; annulet 1 with a few minute setae, annulets 2 and 3 with a transverse row of a few stiff brown setae together with very minute setae scattered around the larger setae; subspiracular tubercles obsolete; pedal area prominent, produced laterad and oblique, extending entire length of segment; maxillary palpi normal, four-segmented, segment 1 flattened, with distinct mesal projection, segments 2 and 3 cylindrical, segment 4 minute, peg-like; labial palpi normal, three-segmented; larvapods located close together near the meson, proximal portion chitinized, setiferous, distal portion small, membranous, non-setiferous, bluntly rounded, those on seventh or eighth abdominal segment lacking membranous distal portion.

The genus is divisible into two sections by the structure of antennae and number of larvapods. Owing to the incompleteness of published records of larvae of this genus, involving in some cases confusion in specific identification, it is not possible to determine many of the specimens collected. The following key will separate the species represented in the collections studied.

SPECIES OF HYLOTOMA

1(10) Antennae distinctly conical or peg-like, twice as long as wide; larvapods on abdominal segments 2-6 and 10, seventh segment with rudimentary pair; head always uniformly blackish, brownish, or yellowish; body always with numerous minute blackish spots arranged longitudinally along subdorsal, dorso-lateral, supraspiracular and pedal lines.....2.

2(5) Head always black, thoracic legs with all segments blackish; tenth abdominal tergum blackish.....3.

3(4) Tenth abdominal segment on ventral half blackish; area between larvapods with minute colored spots; area ventrad of pedal folds with minute spots; latus of each segment with a few very minute secondary setiferous spots besides regular tuberculate spots; on Crataegus Y-194-3 194-2; on Prunus? Y-194-5....*Hylotoma* sp. 1.

4(3) Tenth abdominal segment on ventral half unmarked, whitish; area between larvapods without minute colored spots; area ventrad of pedal folds without minute spots;

latus of each segment without minute setiferous spots; on Alnus: Y-194-4..... *Hylotonia* sp. 2.

5(2) Head not always blackish but usually yellowish or brown; thoracic legs not with all segments blackish, segments distad of coxa usually brownish or brownish yellow; tenth abdominal tergum not always blackish.....6.

6(7) Head blackish; tenth abdominal tergum yellowish; subanal lobe yellowish; spots between larvapods numerous and brownish; latus of each segment with many very minute secondary setiferous spots; tuberculate spots of body yellowish with brown border; on oak; Y-214-1-2.....*Hylotoma* sp. 3.

7(6) Head yellowish or reddish brown; tenth abdominal tergum blackish; subanal lobe whitish.....8.

8(9) Area ventrad of pedal folds with many minute setiferous spots; area between larvapods sometimes with spots; spots on body not uniformly blackish or brownish but blackish on cephalic and also usually on caudal portion of the body those on middle portion brownish or yellowish with brown border sometimes spots all pale yellowish brown; head reddish or yellowish brown; on Crataegus; Y-222..... *scapularis* Klug.

9(8) Area ventrad of pedal fold without spots; area between larvapods never with spots; spots on body uniformly blackish or brownish; head yellowish or yellowish brown; on elm; C-C.U. 668 Y-29-24.....*Hylotoma* sp. 4.

10(1) Antennae button-like, usually wider than long; larvapods on abdominal segments 2-7 and 10, eighth segment with rudimentary pair; head blackish brownish or with a distinct median streak from occiput to front; body sometimes not spotted except on each side of the meson on cephalic segments.....11.

11(14) Head blackish or brownish; body distinctly and regularly spotted; tenth abdominal tergum and subanal lobe usually blackish; thoracic legs usually with coxae blackish or brownish and other segments brownish or grayish.....12.

12(13) Tenth abdominal tergum and subanal lobe whitish; all colored areas or spots of body brownish; area between larvapods with few setiferous spots; area ventrad of pedal fold with many setiferous spots; on *Salix discolor;* C-Young 61....*Hylotoma* sp. 5.

13(12) Tenth abdominal tergum and subanal lobe blackish or brownish; all colored areas or spots blackish or brownish; area between larvapods usually without setiferous spots; area ventrad of pedal fold with varying number of spots; on Prunus; Y-1946-1 G-Onekama No. 23; Maine 1915; C-C.U. 656 C.U. sub. 64.....*Hylotoma* sp. 6.

14(11) Head yellowish or light brownish with brown streak along epicranial stem; body not regularly and distinctly spotted except along dorso-meson on cephalic segments; tenth abdominal tergum never blackish or brownish; thoracic legs always concolorous with body; Y-185-1-2 (Azalea) Y-185 (Willow) M-113 (birch bred) M-108 (hazel).....*macleayi* Leach.

Subfamily Schizocerinae

Larvae (Fig. 24) small; body subcylindrical, flattened on venter, tapering caudad, mesothoracic and metathoracic segments somewhat swollen, prothorax distinctly tapering cephalad; whitish or creamy white, never spotted or striped; segmentation and annulation indistinct; third abdominal segment with three annulets, all annulets provided with a transverse row of tubercles; spiracles on annulet 1; tenth abdominal tergum without suranal or caudal protuberances; larvapods on abdominal segments 2-8 and 10, the venter of ninth segment with a pair of minute

protuberances; thoracic legs modified, prothoracic legs apparently four-segmented, distal segment pad-like, tarsal claws wanting; mesothoracic and metathoracic legs apparently three-segmented, distal segment pad-like with a sharp claw on cephalic side; antennae apparently one-segmented, segment large with several clear spots; antennaria ventrad or slightly caudad of ocularium; spiracles winged; glandubae obsolete; in younger specimens larvapods sometimes very indistinct; tubercles often indistinct; leaf-miners.

The Schizocerinae is represented in the Nearctic region by a single genus, Schizocerus, and includes a limited number of species. Modern systematists have always associated this subfamily with the Hylotominae, the two being separated by the presence or absence of the free part of Sc_2 in the front wing. The larvae of this subfamily are unique in having thoracic legs and maxillary and labial palpi modified by reduction in the number of segments.

Schizocerus Lepeletier

Larvae small, length less than 15 mm., creamy-whitish; head small, pale brown, higher than wide, sparsely and microscopically setiferous; annulation 1, 2, 3; annulets above spiracular lines with tubercles, 2 on annulet 1, four on annulet 2, and three on annulet 3, annulet 1 with a row of tubercles on venter; a row of tubercles between larvapods and surpedal area; subspiracular area not tuberculate or warty; tenth abdominal tergum small, only slightly convex, tubercules almost obsolete, with several stiff short setae on caudal margin; venter of ultimate segment with distinct anal larvapods, subanal lobe with a pair of long and short tubercles on each latero-caudal margin; maxillary palpi apparently three-segmented, distal segment very minute, formula, 2, 1, 3; labial palpi apparently two-segmented; mandibles as viewed from side narrow and slender; totaglossa of labium large; spiracles winged, wings small, oblong; spiracular line dividing the latus into two subequal dorso-ventral parts.

Schizocerus zabriskiei Ashmead.—Head pale brownish-green, body whitish; in younger specimens head brownish, body with minute tubercles touched with brown; legs, and venter between legs brownish; tubercles ventrad of surpedal area and dorsad of larvapods usually three in number in mature larvae and two in younger larvae; mature specimen, length, 13 mm.; width of head, 1.3 mm.; on Portulaca; Y, G.

Schizocerus sp. 1.—Larvae indistinguishable from the preceding species. This species was collected at Muncie, Ill., by Dr. Edna Mosher, who bred adults. It is considered by Dr. MacGillivray to be a new species.

Subfamily Acordulecerinae

Body (Fig. 25) subcylindrical, tapering caudad, venter flattened, thorax distinctly swollen; segmentation distinct; annulation indistinct, third abdominal segment with apparently three annulets, all annulets tuberculate, setiferous; thoracic legs 5-segmented, spreading laterad, distal segment consisting of a sharp recurved claw and caudal membranous globose swelling; prothoracic legs one-half as large as metathoracic; larvapods rudimentary on abdominal segments 2-7 and 10, increasing in size from cephalic pair to sixth pair; tenth abdominal segment truncate, small, without suranal processes; antennae flattened, apparently 1-segmented; abdominal segments 2-4 or 2-5 and 8 with crescentic sucker-like protuberances, one on each postsubspiracular protuberance; ventral glands wanting; spiracles not winged; glandubae wanting.

The Acordulecerinae, according to MacGillivray (1906), is represented on the North American continent by a single genus, Acordulecera. Rohwer would divide the subfamily into two tribes, Acordulecerini and Conocoxini, the former including besides Acordulecera, Pantherix and possibly Thulea and the latter Conocoxa and Nithulea. A radically different arrangement is that of Konow who regarded Acordulecera as one of fourteen genera included in his tribe Lobocerotides which was one of four tribes constituting his subfamily Lophyrini. Konow seems to have been unfamiliar with the larvae of the Nearctic genus Acordulecera, for he speaks of the larvae of Lophyrini as "mit 16 Abdominalbeinen; an Coniferen."—a characterization not at all applicable to the genus under consideration. The host-plant of two species of Acordulecera have been recorded, and one species recognized in the larval stage. I have examined larvae of several unbred species.

Acordulecera Say

Larvae very small, length less than 12 mm., greenish, never spotted or striped; head usually brownish or pale; annulation, 3, (2, 1); prothorax constricted; annulets with transverse row of slight tubercles, each bearing slender peg-like setae; lateral lobes distinct; tenth abdominal tergum with several setae; suranal and subanal lobes with several setae; maxillary palpi rather slender, uniformly tapering distad; mandible thick; labial palpi small; ligula dilated, rounded; free leaf-feeders; gregarious.

SPECIES OF ACORDULECERA

1(4) Sucker-like protuberances on abdominal segments 2-5 and 8.....2.

2(3) Head with vertex blackish brown, front distinctly lighter in color; legs whitish concolorous with body; sucker-like protuberances with three marginal setae; length 9.5 mm.; width of head 1.2 mm.; on butternut; Y-8.93(?)-2-2...*Acordulecera* sp. 1.

3(2) Head with vertex light brown, epicranial stem deep brown, front sometimes deep brown; in young specimens head entirely dark brown; legs brown; sucker-like

protuberances with three marginal setae; length 11 mm.; width of head 1.3 mm.; on chestnut and butternut; Y-93 C-cu 667.....*Acordulecera* sp. 2.

4(1) Sucker-like protuberances on abdominal segments 2-4 and 8.....5.

5(8) Sucker-like protuberances with three marginal setae; on oak.....6.

6(7) Head light brown with epicranial stem deep brown or brownish with vertical furrows lighter in color; legs brownish; length 9 mm.; width of head 1.2 mm.; Y-131 -137, C-cu 680, M-37.....*Acordulecera* sp. 3.

7(6) Head yellowish or light brown, with epicranial stem concolorous with body; length, 7 mm.; width of head, 1.1 mm.; M-239, M-243, C-y11.....*dorsalis* Say.

8(5) Sucker-like protuberances with five marginal setae; head deep brown, vertical furrows and epicranial arms lighter in color; legs whitish, concolorous with body; length, 9 mm.; width of head, 1.2 mm.; on hickory; Y-144-5.....*musta* MacGillivray.

Family Pamphiliidae

Larvae (Fig. 1) of medium size; body subcylindrical, slightly flattened on the ventral aspect; sublateral lobe on the ventro-lateral margin distinct, moderately large; body slender to robust; segmentation and annulation distinct; cuticle microscopically setiferous, appearing smooth, often delicate, transparent; color usually greenish or creamy white; head semiglobose, prominent, as wide as thorax; color creamy or brownish or blackish; mouth directed ventrad; head completely exposed, sparsely setiferous; epicranial suture and vertical furrows present; antennae extremely long, setaceous, conspicuous, seven-segmented; ocularia located ventro-laterad of antennariae; mouth-parts normal, sericos produced and prominent; prothorax with shield-like, usually brownish, broad patches on the dorsal and lateral aspects; thoracic legs modified, setiform, sharply pointed, segments cylindrical, distal segment very long, slender, straight; third abdominal segment with four annulets on dorsal and ventral aspects; spiracles on the second annulet; larvapods wanting; eighth abdominal segment on the venter mesad of the lateral lobe with a fleshy protuberance resembling a larvapod, ninth segment cylindrical, smaller than the preceding; tenth segment depressed, rounded on the caudal margin, usually setiferous, sometimes conspicuously so, often with colored patches, always with a median hook-like suranal process near the caudal margin of the tergum; subanal lobe with a pair of setiform, three-segmented conspicuous subanal appendages; insects one- or two-brooded; spinning silken web or rolling leaves for their nests; solitary or gregarious; pupate in the ground.

The Pamphiliidae is an easily circumscribed family of eight or nine genera and a large number of species which are peculiar to the Northern hemisphere. The adults differ from all other Hymennoptera except the Xyelidae in the preservation of the subcostal vein in the hind wings. In this character it is more generalized than the Xyelidae altho it is more specialized than this family in other features of venation. Brischke

and Zaddach (1865) discussed the immature stages and biology of eleven European species of the Pamphiliidae and pointed out that certain of their habits may be of taxonomic significance. The larvae of these species fall into one or the other of two groups according to the type of nests they build. The first group contains those whose larvae build nests by tying the leaves of their food-plants together with threads of silk and are either solitary, as Lyda, or gregarious, as Cephaleia and Neurotoma. The second group consists of those whose larvae build nests by rolling the edge of the leaves of their food-plants and live inside the tubes so formed, as Pamphilius. Some of this latter group make portable nests out of detached pieces of leaves, as *Pamphilius inanitus* on Rosa. The adults, however, are so closely related to each other that Rohwer (1911) considered such a subdivision impractical. Konow (1901), in his analytical table of the larvae, included sixteen species, representing four genera, but did not register any Nearctic species. According to this writer (1905) the larvae of Lyda and Cephaleia feed on coniferous plants while those of Neurotoma and Pamphilius attack deciduous plants. Nothing is known concerning the biology of Anoplolyda. Dyar (1895) included in his table ten Nearctic pamphilids but, excepting *Pamphilius ocreatus*, all were unidentified and many were taken from descriptions given by Packard (1890).

Of about fifty-five Nearctic species representing seven genera, Acantholyda, Itycorsia, Cephaleia, Caenolyda, Neurotoma, Pamphilius, and Anoplolyda, only five species have been identified in the larval stage, and the food-plants of about six species recorded.

Four identified and several unidentified species have been examined. It is not possible to define the genera with this limited material; the species studied can be separated as follows.

SPECIES OF PAMPHILIIDAE

1(14) Subanal appendages with the second segment longer than or subequal to the third segment, never distinctly shorter; head usually dark-colored; tenth abdominal tergum with colored patches.....2.

2(3) Subanal appendages with the second segment subequal in length to the third, all segments black; first segment longer than the two distal segments taken together; head black; body olive-green with yellowish lateral lobes; on spruce; Packard (1890)-35.....*Pamphiliid* sp. 1.

3(2) Subanal appendages with the second segment longer than third, the third usually darker in color than the others; first segment longer than or nearly equal to the two distal segments taken together; head dark brown to green.....4.

4(5) Head green; tenth abdominal tergum without colored patches; body green; subanal appendages with the second and third segments black; on *Pinus strobus;* Packard-83. *Pamphiliid* sp. 2.

5(4) Head not green, usually brownish; tenth abdominal tergum with or without colored patches; body not greenish, sometimes reddish or olivaceous; subanal appendages usually with segments brownish; on Pinus and Abies.....6.

6(13) Head brown to yellowish.....7.

7(12) Head dark brown.....8.

8(9) Head paler along epicranial arms; subanal appendages with first segment as long as all the other segments taken together; all segments pale to light brown; length, 25 mm.; width of head, 3 mm.; body robust, large; following parts dark brown: head except along epicranial arms, prothoracic shields, thoracic surpedal lobe, coxae, sterna between thoracic legs, cervical sclerites, markings on the tenth abdominal segment, median suranal process, and antenae; ocellarae black; suranal process short and erect; tenth abdominal tergum with a pair of lateral patches, not connected along caudal margin; tenth abdominal sternum with a median brown patch, distinctly rounded on cephalic margin; subanal appendages light brown, first segment equal in length to other two taken together, segment 2 longer than 3; thoracic legs with fifth segment as long as fourth, and third taken together; antennal formula: (2, 5), 3, 6, 1, (4, 7); cuticle distinctly reticulate, each area brownish; three specimens in MacGillivray collection bearing label "Cephalaeia sp. No. 839? Maine." (The identification is open to question, but, since these larvae are readily distinguished from the larvae of Pamphilius and Neurotoma by the characters used in the table here, they may be considered, tentatively at least, as representing the genus Cephaleia.).....*Cephaleia* sp. 1.

9(8) Head not paler along epicranial arms, but uniformly brownish.....10.

10(11) Head pitch-brown; body pinkish to reddish brown; on spruce; Packard-36.....*Pamphiliid* sp. 3.

11(10) Head horny brown; body horny brown; subanal appendages with first segment longer than other two taken together, third segment brown; on *Pinus strobus;* Packard-84.....*Pamphiliid* sp. 4.

12(7) Head yellowish to brownish yellow; body pale brick-red or yellowish, each segment with a large reddish spot on the spiracular line; subanal appendages with first segment nearly equal in length to other two taken together; all segments blackish; on *Pinus strobus;* Packard-85.....*Pamphiliid* sp. 5.

13(6) Head pale red, with a black spot on the front; body reddish olive-green with purplish meso-dorsal line; on Austrian pine; closely related to *Lyda campestris;* Packard-82.*Pamphiliid* sp. 6.

14(1) Subanal appendages with the second segment distinctly shorter than the third; head variously colored, blackish to pale; tenth abdominal tergum either with or without colored patches.....15.

15(18) Tenth abdominal tergum with a colored patch on each side, median triangular patch between the cephalic ends of the lateral patches wanting; lateral patches connected along the caudal margin of tergum; sternum with a large colord patch.....16.

16(17) Head blackish or dark brownish, in younger specimens pale brown; subanal appendages with first segment longer than other two segments taken together, third longer than second, all segments brown, the third darker; cervical sclerites pale brown, dorsal and lateral shields of prothorax pale to light brown, patches on the ultimate segment brownish; body with a pink dorsal line on the meson; antennae in mature specimens with formula, (2, 3, 5), 1, 7, (4, 6); ocularium about one-third the diameter of antennaria; ocellarae small, eccentric, near the mesal margin of ocularium; mouth-parts brownish; length, 19 mm.; width of head, 1.9 mm.; on wild cherry; G.....*Neurotoma fasciata* Norton.

17(16) Head lighter in color, yellowish, sometimes brownish yellow; subanal appendages with first segment nearly equal to other two taken together, all segments black; following parts blackish: prothoracic shields, thoracic legs, markings on ultimate segment, subanal appendages, ocularia, thoracic sterna; the black markings of tenth abdominal

tergum connected along the caudal margin; black marking of tenth sternum large, completely covering the sternum, and with its cephalic margin between the subanal appendages straight; antennae with formula, (3, 5), 2, 1, 7, (6, 4); length, 18 mm.; width of head, 1.7 mm.; on plum; G.....*Neurotoma inconspicua* Norton.

18(15) Tenth abdominal tergum either with a colored patch on each side and with a median triangular patch between the cephalic ends of the lateral patches always present, the lateral patches sometimes not connected along the caudal margin of the tergum, the sternum with a large colored patch; or the tergum without colored patches and the sternum either with a pair of small round spots or without markings.....19.

19(22) Tenth abdominal tergum with two lateral triangular patches and one mesal patch and sternum with a large colored patch.....20.

20(21) Head blackish; body greenish-white; subanal appendages with the first segment longer than the other two taken together, all segments pale brown, the third sometimes darker; following parts blackish: head uniformly, antennae, prothoracic shields, thoracic lateral lobe, markings on ultimate segment, suranal hook, cervical sclerites, and coxae; antennae with formula, (3, 2), 5, 1, 7, (4, 6); eighth uromere with a pair of marginal ventral glands near caudal portion of the sublateral lobe, both pale brown; in life, body glossy white with diffused fleshy-reddish tint; antennae and subanal appendages whitish; length, 19 mm.; width of head, 1.9 mm.; on Cornus; nests made by rolling edges of leaves cut across from the margin to the midrib; gregarious; Y-125.....*Pamphilius* sp. 1.

21(20) Head light brown, with a black spot on the apex of front; subanal appendages with the first segment nearly equal in length to the other two taken together, two proximal segments creamy, third deep brown; body whitish green; ocularia brown, a black spot at the origin of the epicranial arms; following parts brown: thoracic shields, cervical sclerites, and markings on the ultimate segment; tenth abdominal tergum with a median cephalic triangular patch between the lateral patches; subanal appendages with second segment longer than half the length of the third; thoracic legs pale or creamy; antennae, beyond the first segment, deep brown, with formula: (2, 3, 5), 1, 7, (4, 6); length, 19 mm.; width of head, 1.8 mm.; on blackberry; G.....
Pamphilius dentatus MacG.

22(19) Tenth abdominal tergum without colored patches.....23.

23(26) Tenth abdominal sternum without a pair of small colored patches.....24.

24(25) Head uniformly pale brown; subanal appendages with the first segment as long as other two taken together, the second shorter than the third, all segments pale brown; ocularia large, about one-third the diameter of antenaria, black; following parts blackish brown: narrow prothoracic shields, cervical sclerites, and antennae; suranal hook brown without colored base; antennae with formula, (2, 3), 5, 1, 7, (4, 6); length, 12 mm.; width of head, 1.5 mm.; host unknown; Y-163-3. (This species closely resembles *P. persicus* MacG.).....*Pamphilius* sp. 2.

25(24) Head not uniformly pale brown, vertex brown, front with a brown spot; subanal appendages with the first segment as long as the other two taken together, distal two segments brownish; following parts brown: prothoracic shields, cervical sclerites, antennae, and suranal process; legs pale brown, darker in young specimens; length, 17 mm.; width of head, 1.8 mm.; on blackberry; M-69.....*Pamphilius* sp. 3.

26(20) Tenth abdominal sternum with a pair of small colored patches; head pale to light brown, front sometimes with a brown spot, usually without it; subanal appendages with the first segment nearly equal in length to other two taken together, the second segment shorter than the third, all segments pale to brownish; ocularia and mandible at distal end blackish brown; suranal process brown with its base pale; antennae

brown; tenth abdominal sternum with small brown round spot on each side; length, 16 mm.; width of head, 1.6 mm.; larvae solitary, leaf-edge rollers on Cornus; M.
Pamphilius ocreatus Say.

Family Cephidae

Body (Fig. 2) cylindrical, sometimes slightly depressed, enlarged at thorax, slightly and uniformly tapering caudad, slender or moderately stout; segmentation usually distinct; annulation sometimes indistinct; cuticle smooth or verrucose, microscopically and very sparsely setiferous; color generallly pale or creamy white, never with distinct bright marks; head circular in contour, semiglobose, moderately large, narrower than thorax, caudal portion concealed by prothorax, pale brown or concolorous with body, sparsely setiferous; mouth-parts directed ventrad, normal in form, brownish; antennae with four or five segments, conical; ocellarae small, with ocularia less than one-fifth the diameter of antennaria and located latero-caudad of it; epicranial suture and vertical furrows present; mesothorax distinctly, and metathorax with dorsal and lateral aspects somewhat swollen; thoracic legs vestigial, fleshy, mamma-like, tarsal claws wanting; third abdominal segment with two or three annulets, sometimes indistinct; venter with three annulets; larvapods wanting, sometimes with slight swellings in normal position of larvapods; lateral lobes prominent, extending the entire length of the segment; tergum of ultimate segment with mesal longitudinal broad depression and distinct suranal process; sternum of ultimate segment with a pair of inconspicuous vestigial, papilliform subanal appendages ventrad of the cephalic end of the anal slit; internal feeders, boring into the stem of monocotyledonous and herbaceous plants and bushes; pupation in tunnels in the host-plants.

The Cephidae contains about fourteen genera and is moderately rich in number of species, some of them of intercontinental distribution. Nine genera are represented in North America. Practically all systematists have considered this group as a distinct aggregate worthy of family rank. Rohwer (1911), however, has expressed the opinion that future studies may possibly make it advisable to unite this group with the Xyelidae and to treat each of them as subfamilies. There have so far been no facts or reasons brought to light which call for such a step. On the other hand, MacGillivray's study has emphasized the fact that "so far as the wings are concerned, they (Cephidae) are the most distinct of any group of the Tenthredinoidea, and are only indirectly related to any of the other families." They are generalized in the manner of the origin of media but are specialized in other features of the wings. On the basis of larval characters this family is related to the Pamphiliidae and is quite unrelated to the Xyelidae.

The systematic position of the osculant genus Syntexis is unsettled. In the original description Rohwer (1915) stated that this genus has

affinities with both the Cephidae and Xiphydriidae and on the basis of venation, it probably belongs to the latter as defined by MacGillivray. Certain features other than venation, however, led Rohwer to place it in the Cephidae. It is not safe to venture any opinion without careful examination of the larvae, but their antennae and their lack of papilliform subanal appendages suggest close affinity with the Xiphydriidae.

At least six out of sixteen American species have been recognized in the larval stages and their host-plants recorded. *Janus integer* and *Cephus cinctus* are economic pests. Konow's tribe Macrocephides includes the species whose larvae bore into the pith of shrubs and woody twigs, and his tribe Cephides embraces those whose larvae bore into the stalks of Graminaceae.

Middleton (1917) published descriptions and keys for distinguishing the larvae of five species representing four genera, Adirus, Janus, Cephus, and Hartigia together with a definition of the groups based on "characters common to all the genera studied and probably to the family." He reserved for future discussion the question of the systematic position of the Cephidae, but pointed out the obvious affinity of this group with the Siricidae on one hand and the Pamphiliidae on the other. Gahan (1920) described the larva of *Trachelus tabidus* (Fab.) and added a key for separating this larva from that of *Cephus cinctus* and *C. pygmaeus*.

GENERA OF CEPHIDAE

1(10) Papilliform subanal appendages present on the ultimate abdominal segment.....2.

2(3) Suranal process depressed on the distal portion, oval in cross-section, with strongly chitinized dentiform tubercles on the proximal portion; antennae five-segmented. *Janus* Stephens.

3(2) Suranal process not depressed on the distal portion, circular in cross-section, with or without strongly chitinized dentiform tubercles on the proximal portion; antennae four-segmented.....4.

4(5) Suranal process proximad of distal cylindrical portion with strongly chitinized dentiform tubercles.....*Adirus* Konow.

5(4) Suranal process proximad of distal cylindrical portion without strongly chitinized dentiform tubercles.....6.

6(7) Terga of eighth and ninth abdominal segments setiferous, each with a transverse row of distinct setae; tenth abdominal tergum as viewed from side strongly convex and truncate on the caudal aspect; suranal process with stiff setae not arising from distinct chitinized bases.....*Trachelus* Jurine.

7(6) Terga of eighth and ninth abdominal segments glabrous, each without a transverse row of distinct setae; tenth abdominal tergum as viewed from side not strongly convex and not truncate on the caudal aspect but gradually declivous caudad; suranal process with stiff setae arising from distinct chitinized bases.....8.

8(9) Suranal process with distal chitinized portion very short and ring-like, or very long and cylinder-like, more than twice as long as wide; suranal process with a single transverse row of setae proximad of the distal chitinized portion or with two or more whorls of setae; the distal margin of the distal chitinized portion not distinctly serrate.....*Cephus* Latreille.

9(8) Suranal process with distal chitinized portion, as long as wide, cylinder-like; suranal process proximad of the distal chitinized portion with two or more whorls of setae; distal margin of the distal chitinized portion minutely but distinctly serrate..... *Hartigia* Schiodte.

10(1) Papilliform subanal appendages on the ultimate abdominal segment wanting. *Syntexis* Rohwer.

Should Cephus and Hartigia (Middleton, 1917) and Trachelus (Gahan, 1920) prove to possess five-segmented antennae, as reported, contrary to the observations of the present writer, the genus Janus can be separated from them by the chitinized dentiform tubercles and Trachelus by the glabrous eighth and ninth abdominal terga.

Janus Stephens

Antennae distinctly with five segments; segments 1 and 2 short, ring-like, segment 3 longer, but half as wide as segment 1, segment 4 cylindrical, longer than wide, segment 5 elongate-conical, twice as long as wide, subequal in length to or shorter than segment 4; suranal process short, strongly chitinized, nearly as long as wide at proximal end, dentiform tubercles with circular rows of stiff setae on the proximal half, distal half small, depressed, narrowly oblong in cross-section; subanal appendages peg-like, with a minute seta at the distal end, apparently segmented, without setae near the proximal end; lateral area of suranal lobe with 2-3 setae; mandible with four dentes.

SPECIES OF JANUS

Subanal appendages distinctly two-segmented, segment 1 ring-like, much larger in diameter than segment 2; antennae with segment 5 about one-half as long as segment 4; bores in Salix and Populus.....*abbreviatus* Say.

Subanal appendages indistinctly two-segmented, segments subequal in diameter; antennae with segment 5 subequal in length to or only slightly shorter than segment 4; bores in Ribes species (currant); C.....*integer* Norton.

Adirus Konow

Antennae distinctly with four segments; segment 4 long, peg-like, bluntly pointed, nearly three times as long as wide, twice as long as segment 3; suranal process large, distal fourth strongly chitinized, suddenly constricted, circular in cross-section, with chitinized dentiform tubercles; subanal appendages peg-like, fleshy, apparently unsegmented, with setae near the proximal end, these setae separated from the remainder of the setae on the sternum; lateral area of suranal lobe with 20-28 setae.

Adirus trimaculatus Say.—Middleton has described the larvae in detail. They bore in the stems of blackberry and rose. Thru the kindness of Dr. E. P. Felt, one mature and two young damaged specimens from

the New York State Museum, labeled "a 2766" and "a 2261" were examined by me.

Trachelus Jurine

Antennae apparently with four segments—according to Gahan five segments present; body thickest dorso-ventrad in mesothorax, second and third abdominal segments widest, the ninth and tenth tapering suddenly; suranal process rather short, tapering caudad gradually, chitinized dentiform tubercles wanting, with or without stiff short setae, if setae present they do not arise from chitinized bases; ultimate tergum setiferous on both sides of the median depression, convex as viewed from side, truncate on the caudal aspect, not declivous caudad; third abdominal segment with three annulets, annulet 2 largest and with a transverse row of setae; subanal appendages peg-like, unsegmented.

Trachelus tabidus Fabricius.—Suranal process without distinct constriction, with or without brownish setae, if present, setae arranged in a irregular circle in the proximal half; subanal appendages brownish with 2 minute setae at the distal end, and with 1 or 2 setae which are separated from the remainder of the setae on the sternum; lateral area of suranal lobe with 5-7 setae; antennae with segment 4 bluntly rounded, segments 2 and 3 ring-like, segment 1 narrow but large in diameter with a seta on the dorsal margin, segments all brown; bore in the stalks of wheat, rye, and barley (Gahan 1920).

Cephus Latreille

Antennae apparently with four segments—according to Middleton five segments present—segment 4 less than twice as long as wide; abdominal segments 5-8 with ventral swellings corresponding in position to larvapods; suranal process without chitinized dentiform tubercles, either with a narrow ring-like distal chitinized portion and a semicircular row of setae or with a long cylindrical distal portion and two or more irregular rows of whorls of setae on the proximal portion; the distal margin of the distal chitinous portion entire and smooth; subanal appendages papilla-like, cylindrical, more than twice as long as wide, bluntly rounded at the distal end, with one or more setae near the proximal end; lateral area of suranal lobe with 7-15 setae; mandible with three dentes.

According to Rohwer (1917) only two species of this genus are known to occur in North America. They can be separated as follows:

SPECIES OF CEPHUS

Suranal process with the distal chitinized portion cylindrical, twice as long as wide, setae on the proximal portion arranged in two or three irregular whorls; subanal appendages with several setae; lateral area of suranal lobe with about 15 setae; the only true Nearctic species known; bores in stalks of Elymus, Agropyron, Phleum, and wheat. *cinctus* Norton.

Suranal process with distal chitinized portion ring-like, shorter than wide, setae on the proximal portion arranged in a semicircular row on the dorsal aspect; subanal appendages with one or rarely two setae, lateral area of suranal lobe typically with seven setae; introduced from Europe; bores in stalks of wheat.....*pygmaeus* Linnaeus.

Hartigia Schiodte

Antennae apparently with four segments—according to Middleton (1917) with five segments—segment 4 longer than segment 3, elongate, conical; suranal process twice as long as wide at proximal end, without strongly chitinized dentiform tubercles, with several whorls of spinous setae; subanal appendages two-segmented, sometimes segmentation indistinct, with accompanying setae separated from the remainder of setae of the sternum; lateral area of suranal lobe with 15-20 setae.

Hartigia cressoni Kirby.—The larvae of this species have been described in detail by Middleton. They bore in the stems of Rubus in California. The preceding generic definition was based upon specimens obtained thru the courtesy of Mr. Harry S. Smith, of Sacramento, California, and does not quite agree with that given by Middleton (1917).

Family Xiphydriidae

Larvae (Fig. 3) small; body subcylindrical, thorax and two caudal segments distinctly swollen; segmentation distinct; annulation obsolete; creamy white, no markings; glabrous; thoracic legs rudimentary, fleshy, mamma-like, without tarsal claws; larvapods wanting; ultimate segment with distinct suranal process, without subanal appendages; ocellarae wanting; mouth-parts modified; maxillary palpi apparently two-segmented; antennae apparently with three segments; metaspiracles functionless, very much smaller than abdominal spiracles; cuticle on dorsum smooth, on venter microscopically, sharply, and densely spinulate; tenth abdominal tergum with deep meso-dorsal depression; wood-borers.

The Xiphydriidae contains four genera, Derecyrta, Brachyxiphus, Xiphydria, and Konowia, which may be divided into two groups on the presence or absence of the radial cross-vein in the wings. Systematists have generally considered this group as a subfamily of the Siricidae, but MacGillivray (1906) has elevated it to its present standing on the venational characters, which he has proven to be the most generalized of the specialized Tenthredinoidea. Rohwer (1911) would divide the family into two subfamilies, Xiphydriinae and Derecyrtinae, the latter being monobasic. Of the four genera, two are represented in the Nearctic fauna.

In a recent synopsis of the Nearctic wood-wasps, Rohwer (1918b) tabulates eight species of Xiphydria. He considers that *X. walshii* Westwood, which MacGillivray (1916) assigned to the genus Konowia belongs to the original genus, although the species was unknown to him, and states that "it is possible that it is *provancheri* Cresson." Rohwer suggests

that the specimens which Patten (1878) reared from *Betula nigra* and regarded as *X. attenuata* Norton do not belong to this species but are similar to an undescribed female bearing a Bradley manuscript name. Nothing is known concerning the immature stages of *Konowia basalis* Say. The larvae of Xiphydria are wood-borers and confine their attacks to dead and decaying wood of deciduous trees. European species infest willows, poplar, elm, and birch, and American species, maple, hickory, and birch. Konow (1901) listed four species, *Xiphydria prolongata*, *X. camelus*, *X. longicollis*, and *X. abdominalis* in his key to the larvae of Tenthredinoidea.

Xiphydria Fallen

Larvae comparatively small; thorax distinctly swollen, the metathorax being the largest segment of the body; abdominal segments 1-2 cylindrical, subequal in diameter; third abdominal segment with a single annulet; two caudal segments somewhat globose; sublateral lobe moderately large, extending the entire length of the segment; suranal process comparatively long, with dentiform tubercles near the base; tenth abdominal sternum much smaller than the tergum; head and ultimate segment with long setae; head semiglobose, vertical furrows present; epicranial suture in part indistinct; antennariae distinct; antennae three-segmented, segments 1 and 2 ring-like, segment 3 conical, longer but of much smaller diameter than the preceding segments; labium very small, without median emargination; mandibles with distinct dentes; maxillae with small modified palpi, apparently two-segmented; galea conical, smaller than palpi, lacinia fleshy, tubercle-like, with several setae; labium with submentum and mentum large, convex, membranous, palpi apparently with three segments, small, median lobe large, flattened on venter, suboblong; spiracles large, oblique, not winged; glandubae wanting.

Xiphydria provancheri Cresson.—Length, 12 mm.; width of head, 1.6 mm.; body yellowish white; head creamy white; mouth-parts brownish; suranal process arising from large brownish strongly chitinized suranal lobe, deep brown, at proximal end, more than twice as long as wide, distal two-thirds suddenly and distinctly smaller in diameter than proximal third, with two circular rows of dentiform tubercles and setae on the proximal third and two distinct ventral dentiform tubercles on the distal third, one caudad of the other, these without setae; on birch.

This description is based upon a rare specimen collected at Saranac Inn, New York State, Aug. 20, 1900, and generously loaned by Dr. E. P. Felt. The larva bores into partly decayed heartwood of standing birch and makes a gallery about 2.5 mm. in diameter. The burrows are invariably filled with the borings, except a short curved portion thru which the adult makes its way to the surface. A parasite, *Pammegischia xiphydriae* Ashmead, was reared by Dr. Felt from larvae of this species.

Dr. Felt (1906) also found another larva making moderately large cylindrical burrows in decaying birch and considered it as probably belonging to *X. attenuata.* He refers to the rearing of this species by Patton and suggests *Rhyssa humida* Say as its parasite. Since the identity of Patton's specimen is questioned and since the adult was apparently not reared, it is not possible to identify the specimen under consideration. If it were really *X. attenuata*, then it should be known as *X. abdominalis* as proposed by Konow (1905) and Rohwer (1918).

Family Siricidae

Body large, 30-40 mm., cylindrical, uniform in diameter thruout (Fig. 4), fleshy, plump; integument smooth, transparent, non-setaceous, light in color; head circular, half as high as thorax; mouth directed ventrad, mostly exposed, but slightly overlapped by prothorax; antennae inconspicuous, apparently one-segmented; ocellarae wanting; epicranial suture wanting and vertical furrow indistinct; mouth-parts not normal in form, light in color; prothorax large; mesothorax and metathorax short in comparison with abdominal segments; legs rudimentary, mamma-like, subequal in size, borne on fleshy conical lobes; larvapods wanting; typical segment with two indistinct annulets, sublateral lobe distinct but not prominent; tenth abdominal segment semiglobose in profile; tenth tergum distinctly depressed by a median furrow; suranal lobe on the meson with dark colored, chitinized, suranal process; subanal appendages wanting; internal-feeder, bores in the trunks of deciduous and evergreen trees.

The Siricidae contains five genera and about fifty species, most of which are confined to the northern hemisphere. The recognition of the fact that these insects constitute a well-circumscribed group dates back to the time of Linnaeus (1758) who described five species of Siricidae among those of his heterogeneous genus Ichneumon, three of the five having become the types of three modern genera. Systematists have universally agreed in considering this group worthy of family rank. The family falls into two natural divisions, Siricinae, including three genera, Sirex, Urocerous, and Xeris, and Tremecinae, embracing two genera, Tremex and Teredon. The genus Xeris was associated with the genera composing the Tremecinae both by Ashmead (1898) and Konow (1905), but Rohwer (1911) proposed a more natural arrangement, placing this genus in the Siricinae. Bradley (1913) definitely divided the two groups on the number of segments of labial palpi and the retention of cerci in the adults.

According to Bradley (1913) there are twenty species reported for North America, representing all the known genera. The specific characters of some common species, as *Sirex nigricornis*, *Urocerus cressoni*, and *Tremex columba*, are subject to a wide range of variation and several varieties have been described. So far as known, the larvae of the Siricinae

are wood-borers attacking conifers, those of the Tremecinae boring in deciduous trees. *Tremex columba*, or three races of this species which infest maple, elm, apple, pear, beech, oak, and sycamore, are the best-known examples. The food-plants of only three American species are known, these including *Sirex cyaneus* and *Urocerus albicornis*. Larvae of the Siricinae have not been examined.

Tremex Jurine

Larvae conspicuously large; body cylindrical, slightly flattened on the venter; large, robust, usually bare except on head and tenth abdominal segment; whitish or creamy white; setae microscopic; head semiglobose, slightly wider than high on cephalic aspect, semicircular in profile, produced to the ventral half of the front, then suddenly truncated, pale brownish; mandibles and coilae deep brown; antennae apparently one-segmented, conical; antacoria partly chitinized and bearing a few small setae; ocellarae wanting; depression mesad of antennaria which is sometimes called the "eye" is a pretentorina; vertical furrows concealed by overhanging prothorax; clypeus small, light in color; labrum transverse, convex, thick, asymmetrical, without median emargination, but with a notch on the right third of slightly oblique cephalic margin; mandibles strong; mandacuta distinct, brown; mandibularia narrow, inconspicuous, maxilla fleshy except subgalea, stipes large; palpi two-segmented, small; galea conical, brown, small, arising from broad shoulder which bears a few tiny setae on the lateral portion; lacinia round, lobe-like, bearing three rows of brown setae, which decrease in length on cephalic or dorsal side; labium compact, submentum narrow, transverse, membranous, mentum convex, lobe-like, deeply emarginate on cephalic margin, ligula round, fitting into the emargination of mentum, palpi small, two-segmented, second segment much smaller than first, conical and brown, sericos large, transverse, distinct, crescentic; prothorax large, produced dorsad and cephalad, overlapping the caudal third of the head; mesothoracic and metathoracic segments about one-half the length of abdominal segments except the first abdominal which is only little longer than the metathorax; thoracic legs rudimentary, mamma-like, short, tipped with tiny chitinized spot, borne on fleshy conical pedal lobe; cervical sclerites wanting; sternum with transverse subtriangular lobes which meet on the meson in front of median lobe between and slightly cephalad of prothoracic legs; metaspiracles as large as abdominal spiracles; abdomen slightly and uniformly tapering to the caudal end; annulation indistinct on dorsum, apparently with but one annulet, the venter with two annulets, the second annulet larger than the first; sublateral lobe prominent, extending the entire length of segment as a single oblique elevation; spiracles large, brown; ninth abdominal segment a little shorter than the eighth; tenth

tergum convex, lateral area of suranal lobe broad, suranal process prominent, deep brownish, strongly chitinized, compressed, with two pairs of small but distinct teeth.

The foregoing definition of the genus is based on one species, *Tremex columba.*

Tremex columba Linnaeus.—Length, 40 mm.; width of head, 4 mm.; ultimate segment with setae as follows: tergum near the caudal margin on each side of the median furrow with a small, brown, sharp, hook-like spine, with tiny setae which arise from large calices; ventral side of suranal lobe with such setae; tenth sternum small; small brown spot at the lateral end of anal slit; subanal lobe non-setiferous; subanal appendages wanting; I-8396; G-.

The eggs of the Pigeon Tremex are oblong-oval, pointed at both ends about 1.2 mm. in length, deposited singly, but in limited area, close to each other; oviposition takes place in early summer, female sometimes fails to withdraw ovipositor and dies *in situ;* larvae on hatching in the wood make a gallery and feed for probably one season; transformation takes place in the burrow; adults emerge thru circular hole, about 8 mm. in diameter. The larvae are parasitizec by *Thalessa lunator* and also by *Megarhyssa atrata* Fabricius, according to Champlain (1921).

Felt (1906) suggests as remedial measure against this insect, the cutting down and burning of all trees badly infested. Keeping the trees in vigorous health is supposed to be sufficient to prevent injury as the larvae work only in weakened or partly decaying wood.

Family Megalodontidae

Antennae long, conspicuous, multisegmented, located above or near the ocellarae; larvapods wanting; last abdominal segment rounded, with a pair of bristle-like segmented subanal appendages; larvae feed on herbaceous plants.

This family contains four genera, Rhipidioceros, Megalodontes, Melanopus, and Tristactus, and about thirty-five species, which are distributed in Europe, Asia, and North Africa. Systematists have invariably associated this family with the Pamphiliidae, but that this position is unnatural has been conclusively shown by MacGillivray. He has pointed out that it represents a line of specialization very similar to that found in the Siricidae, and that while it is more closely related to this family than to any other, an abundance of characters justify one in considering it as a distinct group.

Only one species, *Megalodontes spissicornis* Klug has been recognized in the larval stage. The larvae, according to Hiendlmayr (1878), are found on *Lasperpitium latifolium* L. in central Europe from the end of July to

the beginning of August. In the younger stages, they are gregarious and live in a common nest like many Pamphiliidae, but they spin an individual web when half-grown. There is one generation a year.

This interesting species was not available for study, and the foregoing definition is abstracted from Konow (1901) and may be found by later students of little value in defining the family. This family, so far as the recorded larval characters are concerned, seems to be closely associated with the Pamphiliidae in possessing the bristle-like subanal appendages and long conspicuous antennae. Future observations, however, may possibly reveal more important characters, not given in the brief synopsis of Konow.

Family Oryssidae

Body (Fig. 5) eruciform, grub-like, subcylindrical, slightly depressed, swollen in the middle of the abdomen, tapering at each end; segmentation distinct; annulation obsolete; creamy white, without colored markings; spiracles on prothorax and first eight abdominal segments; thorax increasing in size caudad, thoracic legs obsolete; larvapods wanting; fourth abdominal segment largest in diameter, size of segments decreasing rapidly caudad, last segment smallest; suranal process and subanal appendages wanting; head white, compressed cephalo-caudad, circular in frontal contour, narrower than thorax; antennae with a single segment, papilla-like; mandibles tridentate; maxillae and labium vestigial, fleshy, lobe-like, without palpi; ocellarae wanting; larvae parasitic on wood-boring larvae of Coleoptera; pupation in the pupal cells of the hosts.

The Oryssidae contain six genera and a limited number of species distributed thruout the world. The genus Oryssus alone is represented in the Nearctic region. In former years the family has been associated with the Siricidae, but recently writers are in accord in regarding it as an extremely specialized compact group. MacGillivray (1906) came to the conclusion that "so far as their wings are concerned the presence of the second anal cell in the front wings is the only structure that would place the genus Oryssus in the superfamily Tenthredinoidea"; The group is not only highly specialized in the adult characters but a recent discovery of the parasitic habit of the larvae isolates these Hymenoptera from all other Tenthredinoidea as a unique class. In fact Rohwer and Cushman (1917) have gone so far as to propose a new suborder, Idiogastra, placing it "intermediate between the suborder Chalastogastra—where adult would place it—and the suborder Clistogastra—with which the larva would ally it." Whether this arrangement is acceptable or not, the fact that this group is remarkably well circumscribed and that it represents the summit of an extremely isolated line of specialization in the Tenthredinoidea can not be doubted.

Only one species, *Oryssus occidentalis* Cresson, has been recognized in the immature stages. The definitions given here are based on the descriptions and figures of this species published by Rohwer and Cushman (1917). It is quite possible that future studies may prove them inadequate for the identification of the larvae of other genera and species yet to be discovered.

Oryssus Latreille

Larvae small; epicranial suture faint, arms obsolete; clypeus crescentic, narrow; fronto-clypeal and clypeo-labral sutures distinct; labrum more than twice as wide as long, with shallow mesal emargination; antennaria distinctly elevated, antacoria extensive, mound-like; antennae small, mamma-like; mandibles strongly chitinized, curved, narrow mesal dentis larger than lateral dentes, these subequal in size, sharp; maxillae fleshy, subtriangular, unsegmented lobes; annulation on dorsum indistinct, with apparently two annulets, venter with one; sublateral lobes distinct, extending the entire length of the segments; spiracles visible from dorsal aspect; segments transversely raised and with a few minute tubercles.

Oryssus occidentalis Cresson.—Color white with mandibles and chitinized ridges near the mouth brown; head one-third as wide as the widest segment of the body—the fourth abdominal segment; maxillae with minute brownish spots bearing about three sensory papillae; labium with about four stout setae on each side of meson; prothorax declivous toward the head, forming straight line with the latter in profile, on dorsum subequal in length to mesothorax; metathorax half as long as mesothorax; lengths of abdominal segments as follows: 8, (1, 9), (2, 7), (4, 6), 5, 10 on dorsum, (6, 7, 8), 5, 1, 3, (2, 4), 9, 10 on venter, 8, 7, 4, (1, 2, 5, 6), 3, 9, 10 on latus; tenth abdominal segment one-fourth as wide and one-third as high as the fourth and sixth segments respectively; dorso-cephalic margin of mesothoracic and eighth abdominal segments distinctly, and of metathoracic and abdominal segments 5, 6, 7, 9, 10 slightly convex, and of abdominal segments 2 and 3 concave; ventro-cephalic margin of abdominal segments 1, 6, 7, 8 distinctly, and of 2 and 9 slightly, concave, of 3, 4, and 5 convex, of 1 and 6 with a distinct convex emargination on each side of meson; abdominal segments with the distance from spiracles to dorsal surface uniform on lateral aspect and much shorter than the distance from spiracles to the ventral surface, the latter variable and increasing caudad to the sixth segment and diminishing thereafter; "each thoracic and abdominal segment has dorsally at each side of the middle a low, transverse elevation surmounted by a transverse row of four or five short, stout back-pointing spines"; setiferous elevations on abdominal segments 1-7 and 9 and on metathorax near the caudal margin of the segments, those of prothoracic

and mesothoracic and eighth abdominal segments being in the middle; tenth abdominal segment with small pointed protuberances directed caudad; venter of segments with brownish spots in place of legs; larvae parasitic on the larvae of *Buprestis confluens* Say, *B. laeventris* Le Conte, and possibly other species of Buprestidae.

IV. PHYLOGENY

A classification based on phylogeny is one of the essential concerns of philosophical taxonomy. In order to ascertain the genetic relationship of organisms, synthetic as well as analytic, consideration of evidence drawn from all the branches of biological science is imperative. The indissoluble relation of morphology, embryology, and paleontology to taxonomy is so manifest and familiar that no comments are needed. The time has come, however, when a critical examination of the phylogenetic significance and the taxonomic value of the physiological and biological attributes of animals must be made. Whatever evidence comparative physiology, biochemistry, and genetics may offer should be incorporated as far as possible with the data obtained in other more commonly exploited fields of research. Only in this way is it possible to arrive at a comprehensive, systematic and complete summation of knowledge of animals. This is the primary function of philosophical taxonomy, and in this sense the saying of W. S. Jevons that "science can extend only so far as the power of accurate classification extends," is true.

There are good reasons to believe, however, that even to-day morphology, as of old, holds its supreme place in systematic investigations as it offers fundamental assistance in determining the genetic affinities of organisms. The success of a study of phylogeny based on morphological evidences depends on the ability of the investigator to select the proper structures, to determine the direction and nature of changes undergone by these structures, and to draw legitimate conclusions by judicious interpretation of the facts observed. Data obtained from studies of the external anatomy of the larval stages of entometabolous insects are of necessity incomplete of themselves for determining the phylogeny of the group; yet, in the absence of other means of approach to the problem, they constitute essential facts significant enough to merit careful consideration.

The opinions of scientists in regard to the systematic importance of the characters based upon the immature stages of Entometabola have been divided. There are some who ascribe no importance whatsoever to them and entirely ignore this phase of taxonomy. There are others who recognize the importance of the larvae from the viewpoint of synoptic classification as they are primarily interested in the practical purpose of

synoptic descriptions and keys. There are still others who believe in the intrinsic importance of the immature stages in the study of phylogeny. The reasonableness of the oft-repeated objection which was voiced by Comstock (1918) that the larvae of insects exhibit a cenogenetic development and, therefore their ontogeny bears little or no relation to the phylogeny of the race, must be admitted in regard to certain structures which are entirely too adaptive and too much modified by environmental factors in meeting the trophic requirements of particular species or genera. But admission of this fact is not incompatible with a belief in palingenesis of other structures. Besides, the warning that the cenogenetic peculiarities, which may be of value as distinguishing characters, are of no phylogenetic significance and must, therefore, be judiciously and discriminately distinguished from more important palingenetic characters, applies not only to the classification of the larvae but to the taxonomy of the adults as well. This objection alone does not invalidate a belief in the intrinsic importance of the immature stages from the phylogenetic point of view. While the writer does not minimize the danger of a too confident expectation of finding phylogenetic indices in the successive ontogenetic stages in entometabolous insects, yet he is equally reluctant to abandon his hope in regard to the taxonomic value of the characters of immature insects. The present study is a partial justification of his contention.

Students of the Tenthredinoidea have recognized the practical importance of the larvae in determining the systematic position of different taxonomic units. Norton (1867) stated that "Mr. Walsh has shown that in some species of Euura and Nematus bred by him, it was almost impossible to detect any difference in the imago, while the larvae varied greatly. Doubtless our opinion will be greatly modified by future discoveries." Cameron (1882) was of the opinion that the larvae were of great value in differentiating the tribes and subtribes altho they appeared to be of little use in regard to the genera. MacGillivray (1913) goes further and states that "it was hoped from a study of the immature stages of the Tenthredinoidea that some information might be obtained as to the validity of the species based on obscure anatomical details." Rohwer also often uses the characters of the larvae as collateral evidence in deciding the systematic position of certain subfamilies and genera.

Nothing definite is known in regard to the ancestors of the Hymenoptera beyond the probability that they have somehow arisen from a primitive type of some neuropteroid-like Palaeodictyoptera. The order is considered to be one of the most, if not the most, highly specialized of all insects. Systematists are unanimous in regarding the Tenthredinoidea as the most generalized of the Hymenoptera. It is difficult, if not impossible, to conjecture the primitive larval type of the Tenthredinoidea. Judging, however, from what are universally considered to be generalized

conditions in insects in general and in the Tenthredinoidea in particular, the probable ancestral type of larva may be characterized as follows: body cylindrical; segmentation distinct; annulation indistinct, annulets few in number; head exposed, subglobose, distinct from the trunk; thorax and abdomen more or less similar in structure excepting the three pairs of thoracic legs, which are well developed and consist of five segments, tarsal claws distinct; abdomen with twelve segments including the telson; larvapods present on abdominal segments 1-10; antennae long, composed of several segments; ocellarae present, one on each side of head; mouth-parts well developed, maxillary and labial palpi segmented; tenth abdominal tergum without caudal protuberances or suranal process; eleventh abdominal sternum with a pair of segmented subanal appendages; ten pairs of functional spiracles present, including metaspiracles; larvae free leaf-feeders.

There are, as was pointed out by Comstock (1893), two kinds of characters of phylogenetic importance. "First, characters indicating difference in kind of specialization; and second, characters indicating difference in degree of specialization of the same kind. The former will indicate dichotomous divisions of lines of descent; the latter merely indicate degrees of divergence from a primitive type."

In determining the probable genetic affinities of the families of the Tenthredinoidea, the following structures have been taken into consideration: thoracic legs, larvapods, subanal appendages, ocellarae, antennae, mouth-parts, suranal process, and metathoracic spiracles. The list does not by any means exhaust the structures which might be employed for this purpose, but it is believed that the structures listed offer the most reliable and essential basis for the determination of a phylogeny based upon larval characters. The significant changes in these structures are: addition or reduction of parts; difference in degrees of development of existing parts; and modifications in length, size, shape, and degree of chitinization of the parts. These modifications have been interpreted according to the Comstockian principles quoted above.

The thoracic legs are among the most persistent structures in the adult and larval stages of insects in general, and their absence is unquestionably an indication of specialization by reduction. It is likewise reasonable to assume that any modification of the typical, simple, cylindrical, five-segmented condition as regards the form or the number of segments is a sign of specialization. The legs of the larvae of the Pamphiliidae approximate most closely the primitive condition in the number, shape, and structure of the segments. The tarsal claw is straight and very slender. In the Xyelidae the legs assume a condition different from that of the Pamphiliidae. The differentiation of segments in size and shape has proceeded further and the tarsal claws have become distinctly claw-

like. The legs are very small compared with the size of the body. The Tenthredinidae present a series of conditions which illustrate beautifully cases of modification both by reduction and addition. The typical, well-developed, five-segmented legs undoubtedly represent the normal sequence in development from the condition found in the Xyelidae. The apparently six-segmented condition of the Hylotominae, four-segmented legs of the Fenusinae, and three-segmented condition of the Schizocerinae, together with the development of distal fleshy lobes in the first- and last-named subfamilies are cases of specialization. The fact that the specialization by reduction of segments has not proceeded at the same rate in the last two subfamilies is indicated by the difference in the structure of the segments. It is interesting to note that the prothoracic legs of the Schizocerinae still retain four segments in spite of the fact that in the two caudal pairs the number of segments has been reduced to three. The osculant genus Phlebatrophia is unique among all other Tenthredinidae in having the legs modified to such an extent as to lose all resemblance to normal segmented legs. They have become mere fleshy, indistinctly segmented, clawless protuberances. In this character this genus resembles highly specialized families such as the Cephidae and its allies. The Cephidae, Xiphydriidae, and Siricidae represent a series of modifications in which the changes have resulted in fleshy, vestigial, entirely clawless legs with or without indication of segmentation. Judging from the size and degree of segmentation, the Xiphydriidae is more generalized than the Siricidae and more specialized than the Cephidae. The Oryssidae is entirely apodous, and the fact that it is parasitic on buprestid larvae leaves no doubt as to its extreme specialization.

The larvapods are considered as true appendages of the abdominal segments. Their presence is highly significant from a phylogenetic point of view. The larvae of the Tenthredinoidea are divisible into two types according to the presence or absence of the larvapods. The Xyelidae and Tenthredinidae represent the type with polypodous larvae and the other five families represent the type with apodous larvae. In the first group the Xyelidae possess the maximum number, or ten pairs, of larvapods, while the Tenthredinidae are provided with six to eight excepting certain specialized genera which possess very vestigial or no larvapods. It has not been possible to determine the reason for the invariable absence of larvapods upon the first and ninth uromeres in the Tenthredinidae. It may be that the same mechanical factors which have caused the fusion of anal larvapods in boring larvae like Caulocampus are also responsible for this condition. The size and, to some extent, the structure and position of the larvapods vary within the Tenthredinidae as in the Schizocerinae, Hylotominae, and Fenusinae. It is interesting to note that the gall-making genus Pontania retains normal larvapods as well as thoracic legs, while the

leaf-miners have both thoracic and abdominal legs reduced in the number and size of their segments. The small size and reduced number of segments are correlated with the well-developed thoracic legs of the Hylotominae. In this subfamily the claws are very large, sharply curved, and provided with empodia-like distal structures, indicating a great adaptation for clinging to leaves. This fact is sufficient to account for the reduction of the larvapods. The Pamphiliidae and four specialized families in the same line of development are entirely without larvapods. It is highly desirable to determine whether this apodous condition signifies a common origin of all five families. Upon this question hinges much of the interpretation of the phylogeny of the Tenthredinoidea.

In characterizing the larvae of the hypothetical primodial Tenthredinoidea the abdomen was considered as provided with the maximum number of appendages, including ten pairs of larvapods and a pair of subanal appendages. This assumption is based upon the fundamental fact that the progenitor of insects having evolved from a typical arthropodan organism possessed the typically arthropodan character, abdominal appendages. This assumption is justifiable in view of the following facts: (1) the possession of appendages on all of the abdominal segments is a fundamental arthropodan characteristic; (2) the embryos of practically all insects exhibit at some time during their development rudiments of abdominal appendages; (3) appendages are present on all or some of the abdominal segments in the postembryonic stages of the Apterygota; (4) the gonapophyses of the Exometabola represent the true abdominal appendages in this group of insects; (5) the larvapods and other appendages are present in the larvae of the Mecoptera, Lepidoptera, generalized Hymenoptera, and, possibly, in some other orders,—all these facts indicating the wide occurrence and fundamental continuity of abdominal appendages in the Hexapoda. It is, therefore, not unreasonable to assume that the progenitor of insects, at least in some stage of its development, possessed appendages on all of the abdominal segments. The same argument supports the contention that the ancestors of the Hymenoptera undoubtedly closely resembled the remoter ancestors of the Insecta. The larvae of the progenitor of the Hymenoptera for this reason have been considered as provided with the maximum number, or ten pairs, of larvapods, a pair on each of the first ten abdominal segments and a pair of subanal appendages on the eleventh abdominal segment. If this assumption is true, the larvae of the Xyelidae, which possess ten pairs of larvapods, must be considered as representing the most primitive condition found in the Hymenoptera. Graber (1890) has shown that in the larvae of Hylotoma the larvapods arise from the embryonic limb-rudiments and are directly evolved from them during the development and, therefore, the larvapods are the true appendages of the abdomen, homodynamous

with the thoracic legs and homologous with the abdominal appendages of generalized insects. There is no reason for considering the larvapods of the Xyelidae as embryologically and morphologically different from those of Hylotoma, consequently the larvapods of the Xyelidae must be the true appendages of the abdomen; and since the larvae of this family are provided with the maximum number of larvapods, they must be considered as the most generalized of the Tenthredinoidea. The Tenthredinidae with six to eight pairs of larvapods and certain other morphological and biological characters are unquestionably related to the Xyelidae and probably represent a line of evolution from a xylelid-like ancestral stock. Among the Tenthredinoidea with apodous larvae, the Pamphiliidae, with a pair of segmented subanal appendages, is undoubtedly the most generalized of all five families. The origin of the Pamphiliidae is consequently an important question. For the reasons already stated in connection with the larvapods, the progenitor of the Hymenoptera has been considered as possessing a pair of subanal appendages on the caudal segment of the body. In this character as well as in all others the Pamphiliidae approach most nearly the primitive condition and, except for the absence of larvapods, unquestionably represents the most generalized condition found in the Tenthredinoidea, outranking even the Xyelidae. The loss of larvapods in this case is just as difficult to explain as the loss of subanal appendages in the case of the Xyelidae. These structures, the larvapods and subanal appendages, must have been lost during the course of phylogeny since the progenitor undoubtedly possessed both of these structures, and these two families, in spite of their generalized conditions, must represent the end-products of evolution in their particular lines. It is, then, natural and proper to assume that there have taken place two distinct lines of development from the ancestral type of the Hymenoptera. In the one, the specialization consisted in the suppression of the development of larvapods, as in the Pamphiliidae, and in the other in the suppression of the development of subanal appendages, as in the Xyelidae. These two families, then, represent two independent lines of evolution and are the most generalized families not only of the Tenthredinoidea but of the Hymenoptera. Whether the Xyelidae is more generalized than the Pamphiliidae, or vice versa, must, from the very nture of the case, remain a question till the advancement of our knowledge shall perhaps make the answer possible. There are, however, a few things that should be pointed out regarding this question. If the suppression of the development of larvapods is considered of equal phylogenetic significance with the suppression of the development of the subanal appendages, and if the head and the appendages of these two families alone are compared, there is no doubt that the Pamphiliidae are more generalized than the Xyelidae. But since the subanal appendages are true abdominal appendages homo-

dynamous with the larvapods, and since it is natural to believe that the process of reduction has taken place very slowly by gradual suppression of the appendages, it is not unreasonable to assume that the apodous condition found in the Pamphiliidae represents a much later stage of specialization than the condition of the polypodous larvae of the Xyelidae. The biology of the Pamphiliidae also indicates that this family is perhaps more specialized than the Xyelidae. However, these considerations counterbalance each other, and, when all is said, it is difficult to decide between the two families as to their relative degrees of specialization. This somewhat drawn-out discussion leads to the following conclusions: (1) the progenitor of the Hymenoptera possessed a pair of larvapods on each of the first ten abdominal segments and a pair of segmented subanal appendages on the eleventh segment; (2) the progenitor gave rise to distinct stocks which resulted in the production of larvae with larvapods in one case and with subanal appendages in the other; (3) the Xyelidae represents the former line of evolution and the Pamphiliidae the latter; and (4) the question as to whether the Pamphiliidae is more generalized than the Xyelidae or vice versa is by its nature unanswerable. To the above conclusions it may be added that it is only natural and reasonable to consider the Tenthredinidae as representing the further evolution of the primitive stock from which the Xyelidae had evolved, and the Cephidae, Xiphidriidae, Siricidae, and Oryssidae, in turn, as evolving from the original stock which gave rise to the Pamphiliidae.

The subanal appendages are present only in the Pamphiliidae and Cephidae. In the former they are rather long, setiform, well developed, distinctly three-segmented; in the latter they are minute, vestigial, often fleshy, papilla-like, and indistinctly segmented. Since the embryonic history of these appendages has not been studied, their true nature is not known. There is little doubt but that they are true appendages. If they represent the appendages of the ultimate segment, as has been suggested by certain writers, and correspond to the so-called style of generalized insects, then their presence is an indication of a primitive condition. There is hardly any question as to the common origin of the subanal appendages in the Pamphiliidae and Cephidae, and if these structures represent what they are assumed to represent these two families must have a close affinity.

The ocellarae are present in the Pamphiliidae, Xyelidae, Tenthredinidae, and Cephidae. They are well developed, and are usually accompanied by well-defined ocularia in the first three families. In the Cephidae the ocellarae are vestigial and represented by localized pigmented granules, and lack ocularia. It is significant that the ocellarae are unmodified in the gall-makers and leaf-miners of the family Tenthredinidae, except in Phlebatrophia, where they are reduced in size and the ocularia indistinct. The atrophy of the ocellarae is undoubtedly correlated with the mining habit of the larvae.

The antennae are present in all larvae of the Tenthredinoidea. Judging from the condition obtaining in generalized insects, it is reasonable to consider the antennae of the Pamphiliidae as representing the primitive ancestral type. They are long and setiform in this family and consist of seven cylindrical well-chitinized segments. The Xyelidae is closely related to the preceding family in antennal characters altho a shortening of the length has taken place. In the Tenthredinidae the antennae undergo much modification both in the number and form of the segments. They may be conical, limpet-shaped, or flattened, and the number of segments varies from five to one. The antennae of the Cephidae resemble those of the Xyelidae and some of the Tenthredinidae in shape and number of segments. The antennae undergo steady reduction in size and number of segments in the three remaining families, reaching the extreme of reduction in the Oryssidae, where each is represented by a button-like swelling. The trend of specialization in the antennae is orthogenetic so far as the families are concerned but quite diverse in the subfamilies of the Tenthredinidae.

The mouth-parts, which include the mandibles, maxillae and labium, afford a fertile field for characters which are of interest from a systematic point of view. The mandibles, like the antennae, are the most persistent and ever-present structures in the head of all larvae of the Tenthredinoidea. The maxillary and labial palpi are typically four-and three-segmented respectively. The change is in the reduction in number and size of the segments. The Cephidae is normal in this respect but gradual change takes place in the Xiphydriidae and Siricidae, while in the Oryssidae the change has proceeded so far as to completely obliterate the maxillary and labial palpi. The palpi of Phlebatrophia resemble those of the specialized families. The families represent different stages of specialization, and their relative systematic position can be indicated by the degree of changes in the mouth-parts.

The suranal process which is located on the meson of the suranal lobe or the tenth urotergum is characteristic of the larvae of the Cephidae, Xiphydriidae, and Siricidae. It should not be confused with the caudal protuberances of certain Tenthredinidae, as these two structures are of an entirely different nature. There is a minute hook-like process on the caudo-meson of the tenth abdominal tergum of the Pamphiliidae. It should be noted that in certain larvae of Pontania and Caulocampus the caudal portion of the ultimate tergum is produced caudad as a blunt more or less strongly chitinized protuberance which undoubtedly serves the same function as the suranal process of the specialized families. These two structural modifications of the caudal end of the body, however, are not homologous with each other. The suranal process is undoubtedly

an adaptive structure which has arisen in response to the habit of the larvae and does not represent the true appendages of the segment, to which the suranal lobe belongs. For this reason the caudal process is of less significance phylogenetically than the subanal appendages of the Pamphiliidae and Cephidae.

The metathoracic spiracles of the larvae are either obsolete or vestigial in the majority of the Tenthredinoidea. The larvae of the Cephidae and Siricidae differ from all others in that the metaspiracles are functional and as large as the abdominal spiracles. It is important to ascertain the original condition of the metaspiracles in these families because upon the interpretation of their primitive condition depends their phylogenetic value and hence the relationship between these two families and also between them and other families. It is considered reasonable to assume that the progenitor of insects and hence the ancestor of the Hymenoptera possessed functional spiracles on all the segments of the body including the metathorax, and that their metaspiracles must have been as large as the abdominal spiracles. The closed minute functionless metaspiracles found in the Pamphiliidae, Xyelidae, and others, indicate a condition of atrophy rather than a rudimentary condition, and so far as this character is concerned the Cephidae and Siricidae represent the unmodified primitive condition and some sort of relation between these two families must be assumed. But on the basis of other characters it is not conceivable that these two families evolved one from the other in a linear sequence, apart from and independent of other families; they must have descended from a common stock which also gave rise to other families which exhibit vestigial metaspiracles. If this is true there must have taken place a series of dichotomies starting with functional metaspiracles, one line of development resulting in the loss of this primitive character and the other line of evolution retaining the original condition. By assuming four such successive dichotomies in the line of evolution, the origin and significance of the metaspiracles of the Cephidae and Siricidae can be reasonably explained. At each of the four successive dichotomous divisions which produced respectively the pamphiliid-like progenitor and Xyelidae, Pamphiliidae and the cephid-like progenitor, Cephidae and the xiphydriid-like progenitor, and Xiphydriidae and Siricidae, one line of descent always carried the original character and the other line lost it until this peculiarity was generally sifted out, being retained unmodified only in the Cephidae and Siricidae. In this way the metaspiracles are here considered to be the direct descendant of the primitive structures which remained unmodified thruout the course of evolution of these families. The two families are generalized in this respect indicating a close genetic relation.

The morphological characters discussed are summarized in the following table:

COMPARISON OF VARIOUS STRUCTURES IN THE FAMILIES OF THE TENTHREDINOIDEA

Structure	Pamphiliidae	Cephidae	Xiphydriidae	Siricidae	Oryssidae	Xyelidae	Tenthredinidae
Thoracic legs	5-segmented	Fleshy	Fleshy	Fleshy	Wanting	5-segmented	5-, 4-, 3-segmented
Larvapods	Wanting	Wanting	Wanting	Wanting	Wanting	10 pairs	6-8 pairs
Subanal appendages	Distinct, long	Vestigial	Wanting	Wanting	Wanting	Wanting	Wanting
Ocellarae	Distinct	Vestigial	Wanting	Wanting	Wanting	Distinct	Distinct
Antennae	7-segmented	5- and 4-segmented	3-segmented	1-segmented	1-segmented	7- and 6-segmented	5-, 4-, and 1-segmented
Mouth-parts	Typical	Typical	Modified	Modified	Vestigial	Typical	Typical, rarely modified
Suranal process	Wanting	Distinct	Distinct	Distinct	Wanting	Wanting	Wanting
Metathoracic spiracles	Vestigial	Functional	Vestigial	Functional	Vestigial	Vestigial	Vestigial

The Pamphiliidae, with its long seven-segmented antennae, setiform three-segmented subanal appendages, setiform five-segmented thoracic legs, well-developed typical mouth-parts, together with the absence of larvapods, is unquestionably one of the most generalized families of the Tenthredinoidea. This family differs from the hypothetical type only in the absence of larvapods and reduced metaspiracles.

The Xyelidae, with its fairly long seven-and six-segmented antennae, five-segmented thoracic legs, well-developed typical mouth-parts, together with the presence of ten pairs of larvapods and the absence of subanal appendages, is undoubtedly a very generalized family, quite different from the preceding. The only striking difference from the hypothetical type is the absence of the subanal appendages and functional metaspiracles.

The Tenthredinidae, with its one- to five-segmented antennae, well-developed thoracic legs, and six to eight pairs of larvapods, together with the absence of the subanal appendages, is unquestionably related to the Xyelidae, and if it has not been evolved directly from the latter the two families must have arisen from a common stock. The Tenthredinidae is a phylogenetic complex in itself, and some of the more specialized genera are further removed from the more generalized genera, biologically as well as morphologically, than the latter are from the Xyelidae or their xyelid-like ancestors.

The Cephidae, with its segmented antennae, vestigial subanal appendages, vestigial thoracic legs, normal mouth-parts, absence of larvapods, presence of suranal process, vestigial ocellarae, and large functional metaspiracles, is considered an offshoot of the ancestral stem from which

the Pamphiliidae had previously evolved. The specialization is indicated by the vestigial condition of the ocellarae, subanal appendages, and thoracic legs, on the one hand, and the development of suranal processes on the other. The presence of the functional metaspiracles is of phylogenetic importance. So far as the head characters are concerned, this family resembles the Tenthredinidae to a limited extent, and in some of the generalized genera of the latter the thoracic legs and the caudal portion of the tenth abdominal segment undergo some modifications which in a remote sense simulate the condition in the Cephidae. But since this family differs from the Tenthredinidae, and resembles the Pamphiliidae in the absence of larvapods and the presence of subanal appendages, it is considered more reasonable to ascribe to it a closer relationship to the Pamphiliidae than to the Tenthredinidae.

The Xiphydriidae, with its somewhat modified mouth-parts, three-segmented antennae, fleshly thoracic legs, suranal process, absence of larvapods, the general shape of the body, and its biology, resembles the Cephidae but differs from it in the absence of subanal appendages, ocellarae, and in the vestigial functionless metaspiracles. The absence of the subanal appendages may point to one of the two possibilities in regard to the origin of the Xiphydriidae. This family might have evolved from the cephid-like ancester but have lost the subanal appendages by the completion of the process of atrophy which had already reduced the original distinctly-segmented appendages (similar to those of the Pamphiliidae) to the vestigial papilliform appendages of the Cephidae. The two families under consideration might, on the other hand, have had a common stem which possessed subanal appendages, ocellarae, and vestigial metaspiracles. In the absence of positive support for the first possibility, it is more expedient to consider the second possibility as nearer to the true relationship of the two families, Xiphydriidae and Cephidae.

The Siricidae, with its greatly reduced thoracic legs and mouth-parts together with certain other characters, is considered more specialized than the Xiphydriidae. The presence of the functional metaspiracles and its genetic significance have already been discussed. For the same reason which suggests a common origin for the Cephidae and Xiphydriidae, the Siricidae is considered to have arisen from a common stock which gave rise also to the Xiphydriidae. In the degree of specialization by reduction as well as by addition, this family outranks the Xiphydriidae.

The Oryssidae, with its vestigial mouth-parts, absence of ocellarae, thoracic and abdominal legs, subanal appendages, suranal process, caudal protuberances, and functional metaspiracles, together with its parasitic habit, is unquestionably the most highly specialized family of the Tenthredinoidea. Its morphological and biological characters are so different from other families that it is not easy to ascertain the systematic position

of the family. There are, however, certain considerations which suggest a possible relationship between this family and the Siricidae. Morphologically the oryssid larvae are more closely related to the apodous boring larvae of the Cephidae, Xiphydriidae, and Siricidae than to the polypodous free-living larvae of the Xyelidae and Tenthredinidae. The siricid larvae are more closely related to those of the Oryssidae than to those of the Cephidae and Xiphydriidae. The parasitic habit also suggests a closer relation to the wood-boring larvae since it is more plausible to imagine the possibility of a wood-boring larvae becoming parasitic on other wood-boring insect larvae under some unknown but not entirely inconceivable circumstances than to imagine the development of a parasitic habit *de novo* in free-living leaf-feeders. Since the oryssid larvae are parasitic on the larvae of Buprestis inhabiting plants which are also infested by the larvae of the Siricidae, if any transformation of habit of the larvae has taken place, it is more natural to expect the larvae of the Siricidae or some siricid-like insect to become parasitic than any other larvae. The recent investigation by Baumberger (1919) on the rôle of microorganisms in the physiology of insect nutrition offers a valuable suggestion in regard to the possibility of radical changes in food habits. For these reasons it is considered reasonable to ascribe a common progenitor to the Siricidae and Oryssidae, at least for the time being. It may be added that it is not entirely unreasonable to assume an independent line of evolution for the Oryssidae apart from all other Tenthredinoidea and consider this family as having no close relation to any of the modern families of the Tenthredinoidea. In that case, the Oryssidae must have arisen from the ancestral stock before the Pamphiliidae and Xyelidae had their origin. There is, however, no clear evidence in support of such relation and since the relation is reasonably explained by associating the Oryssidae with the Siricidae, the former is considered the most highly specialized family of the Tenthredinoidea with a common origin with the ancestor of the Siricidae.

The conclusions on the systematic position and relationship of the different families of the Tenthredinoidea based exclusively on larval characters and derived entirely independent of the opinions of the specialists who have paid more attention to the adults are of necessity not the final words on the subject. The true significance of such conclusions lies in their complemental and collateral value. It is interesting on this account to compare the writer's opinion with the conclusions of the modern authorities on this group of the Hymenoptera.

The relationship suggested here supports in its essential points the three more important systems of classification proposed by Konow (1905), MacGillivray (1906), and Rohwer (1911). MacGillivray considered the Xyelidae the most primitive because of the venational character but

recognized the Pamphiliidae as the most generalized from his study (1913) of the immature stages. Had he placed the Pamphiliidae before the Xyelidae and the Cephidae before the Xiphydriidae and Siricidae, his system would coincide exactly with the system based exclusively on the immature stages. Konow and Rohwer both associate the Cephidae with the Pamphiliidae and Xyelidae. This arrangement is partly supported if the affinity between the Pamphiliidae and Cephidae, as suggested in this study, is upheld. The genetic continuity of the Xyelidae and Tenthredinidae is clearly recognized by MacGillivray (1913). The true systematic position of the Tenthredinidae or its equivalent is difficult to express in linear arrangement. The important point to be noted is the fact that these authors and also Morice (1919) consider the Xyelidae and Tenthredinidae as different and apart from the other families of the Tenthredinoidea. The Oryssidae unquestionably merits at least separate family rank. In the absence of requisite knowledge of the larval characters of the Hymenoptera other than the Tenthredinoidea, it is not expedient to venture any opinion on the suggestion made by Rohwer and Cushman (1917) to establish a third suborder, Idiogastra, for the reception of the Oryssidae. Enslin (1911) differs from the authors already mentioned not only in his arrangement of the groups in a descending order but also in treating the Xyelidae and Pamphiliidae as subfamilies of his Tenthredinidae, on a level with the Cimbicini, Lophrini, and others. This study does not support his arrangement. Morice (1919) suggested that "the Lydini (Pamphiliidae Ensl.) may represent a primitive group of Tenthredinidae which had branched off from the main stock before it had developed certain characters," such as abdominal legs. Handlirsch (1908) considered the Siricidae as having evolved from the osculant Juracic group, Pseudosiricidae. The antiquity of the Siricidae is accepted by Morice who expresses his idea of the relationship of the families of the Tenthredinoidea as follows: "We may suppose that the Siricidae are the earlier group, but whether the Tenthredinidae and Lydini had Siricid ancestors, or whether the Siricidae+Cephini+Oryssidae and Tenthredinidae+Lydini are respectively earlier and later branches of a common stock are questions which must be left unanswered."

V. SUMMARY

The larvae of the Tenthredinoidea have proved to be of great value in affording important evidence in regard to the probable phylogenetic relationship of the families included in this superfamily. The more significant conclusions reached in this study are summarized in the form of a synoptic key as follows:

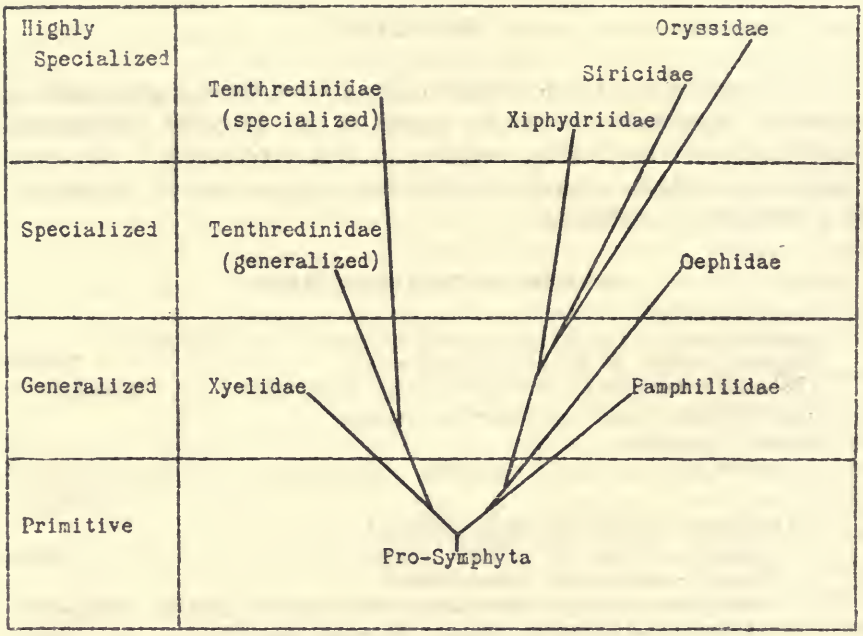
FAMILIES OF TENTHREDINOIDEA

Larvapods present, thoracic legs present, well developed, distinctly segmented.
  Larvapods present on all abdominal segments.....*Xyelidae*
  Larvapods never present on 1st and 9th abdominal segments.....*Tenthredinidae*
Larvapods wanting, thoracic legs present or wanting.
  Thoracic legs present.
    Thoracic legs and subanal appendages well-developed and distinctly segmented. *Pamphiliidae.*
    Thoracic legs vestigial, indistinctly segmented.
      Subanal appendages and ocellarae present.....*Cephidae.*
      Subanal appendages and ocellarae wanting.
        Metaspiracles vestigial, much smaller than abdominal spiracles...*Xiphydriidae.*
        Metaspiracles functional, as large as abdominal spiracles.....*Siricidae.*
  Thoracic legs wanting.....*Oryssidae.*

A synopsis such as the foregoing is necessarily inadequate and somewhat misleading in indicating the affinities of the families. A better idea is gained by means of the customary phylogenetic tree, altho such a scheme also has its limitations. In the following diagram the relation between the families of the Tenthredinoidea is shown. Here the relative vertical positions are intended to represent approximately the degree of specialization; and the continuous lines, the affinities.

The larvae of the Tenthredinoidea are thus divisible into two distinct groups. The first group includes the larvae characterized by the presence of both the thoracic and abdominal legs, and by the absence of the subanal appendages and suranal process, and is represented by the Xyelidae and Tenthredinidae. The second group consists of the five families, Pamphiliidae, Cephidae, Xiphydriidae, Siricidae, and Oryssidae, and is divisible into two subgroups. The first subgroup contains the first four families and is characterized by the absence of abdominal legs, by the

presence of vestigial clawless thoracic legs in the last three families, and by the presence of either subanal appendages or suranal process or both. The second subgroup contains a single family, Oryssidae, which is characterized by the absence of both thoracic and abdominal legs, suranal



Phylogenetic tree indicating the probable affinities of various families of the Tenthredinoidea

process, subanal appendages, and segmented maxillary and labial palpi. The Xyelidae and Pamphiliidae are undoubtedly the most primitive of the first and second groups respectively.

The Tenthredinoidea, therefore, is considered to have developed from a common ancestral stock along two distinct lines of evolution. The first line of development led to the evolution of the Xyelidae and Tenthredinidae and the second line produced the Pamphiliidae, Cephidae, Xiphydriidae, Siricidae, and Oryssidae.

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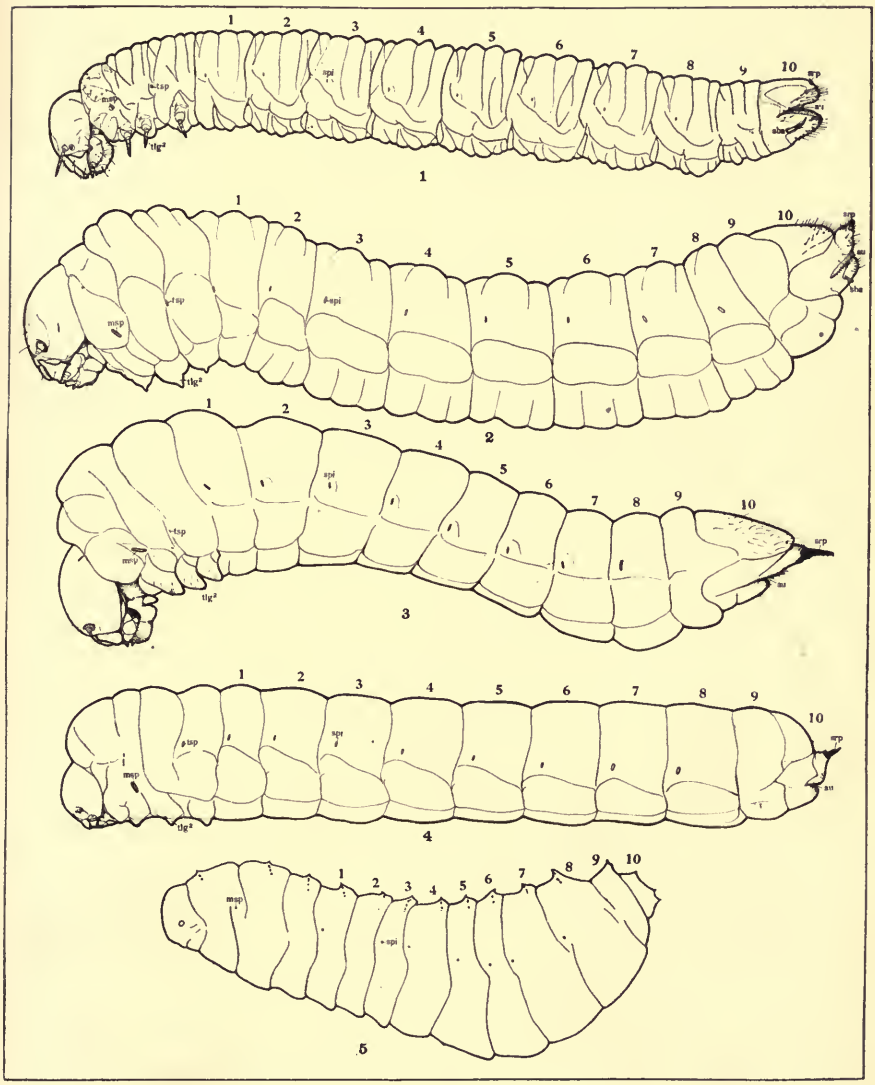
PLATE I

EXPLANATION OF PLATE

LARVAE OF TENTHREDINOIDEA

Fig. 1—Pamphiliidae. *Pamphilius* sp. Y-125.
Fig. 2—Cephidae. *Janus integer.*
Fig. 3—Xiphydriidae. *Xiphydria* sp.
Fig. 4—Siricidae. *Tremex columba.*
Fig. 5—Oryssidae. *Oryssus occidentalis*
(After Rohwer and Cushman, 1917).

au anus
msp mesothoracic spiracle
sba subanal appendage
spi abdominal spiracle
srp suranal process
tlg^{2} mesothoracic leg
tsp metathoracic spiracle



YUASA LARVAE OF THE TENTHREDINOIDEA PLATE I

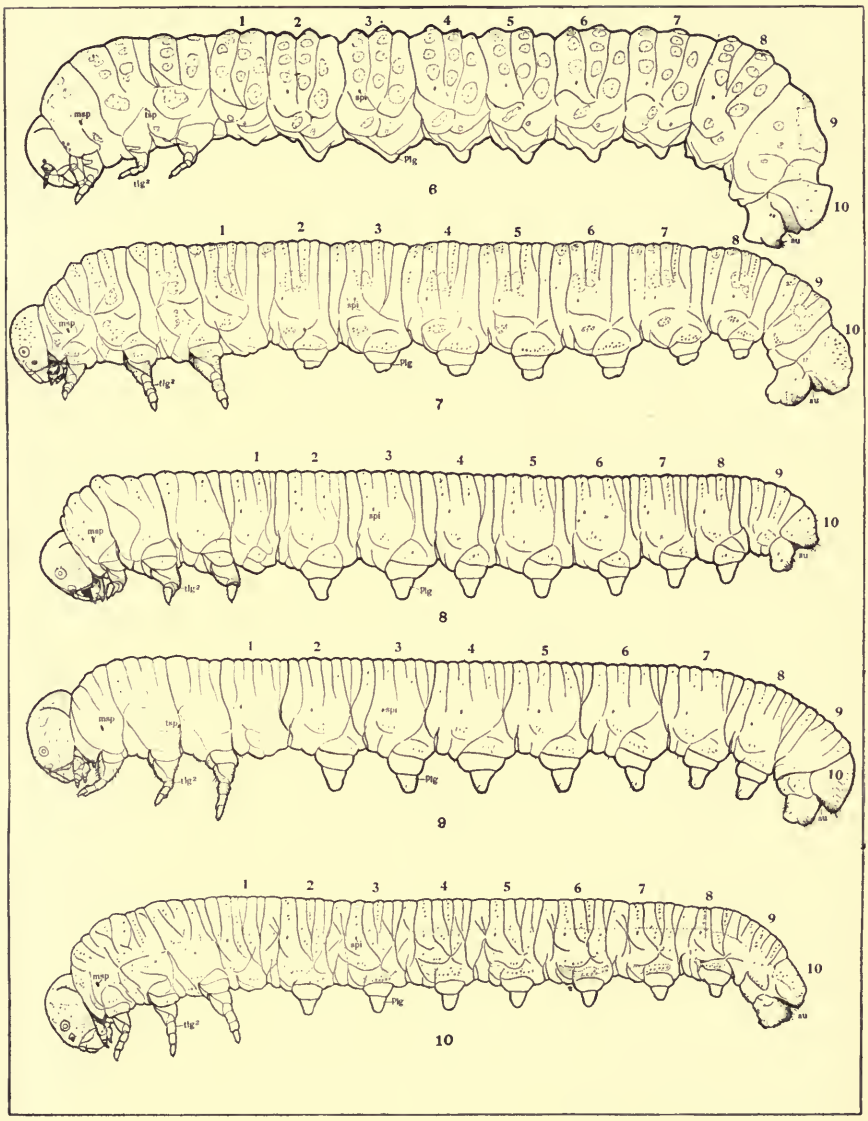
PLATE II

EXPLANATION OF PLATE

LARVAE OF XYELIDAE AND TENTHREDINIDAE

Fig. 6—Xyelidae. *Megaxyela major.*
Fig. 7—Tenthredinidae. Diprioninae. *Neodipriron lecontei.*
Fig. 8—Tenthredinidae. Emphytinae. *Emphytus apertus.*
Fig. 9—Tenthredinidae. Selandriinae. *Strongylogaster annulosus.*
Fig. 10—Tenthredinidae. Dolerinae. *Dolerus similis.*

au anus
msp mesothoracic spiracle
plg larvapod
spi abdominal spiracle
tlg^2 mesothoracic leg
tsp metathoracic spiracle



YUASA LARVAE OF THE TENTHREDINOIDEA PLATE II

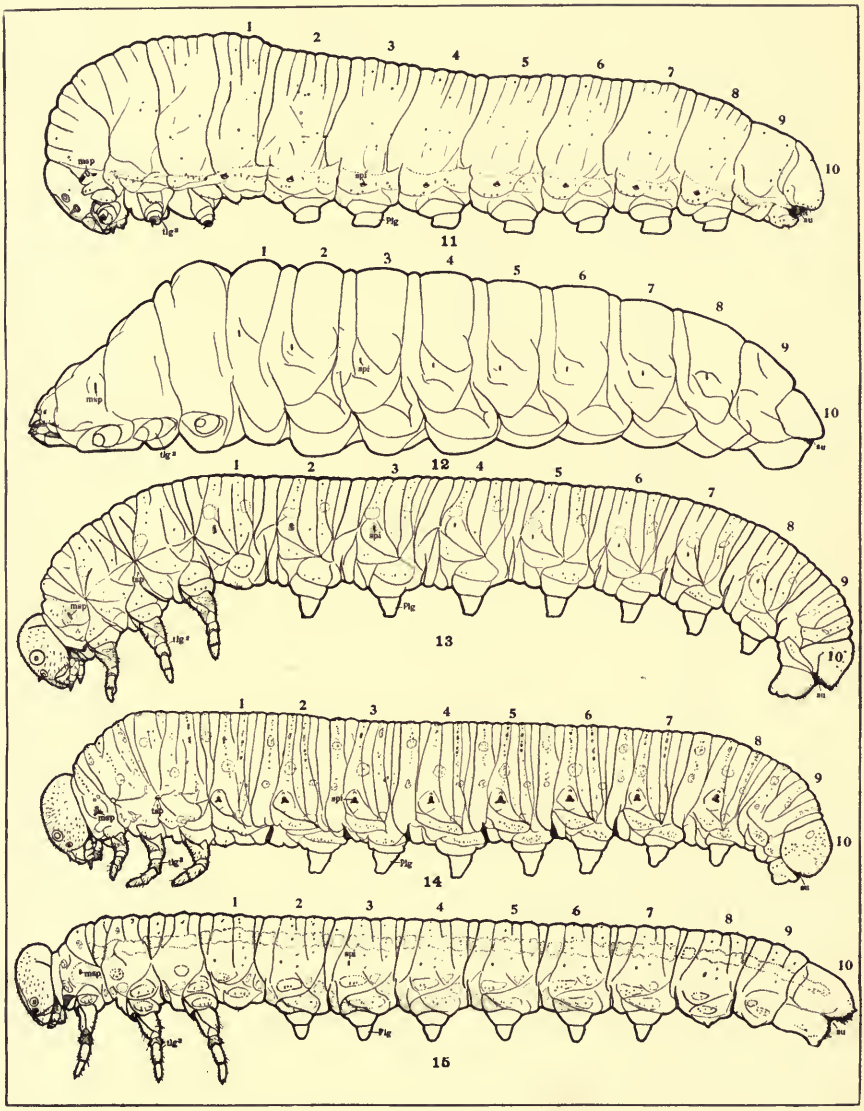
PLATE III

EXPLANATION OF PLATE

LARVAE OF TENTHREDINIDAE

Fig. 11—Phyllotominae. *Caliroa cerasi.*
Fig. 12—Phyllotominae. *Phlebatrophia mathesoni.*
Fig. 13—Tenthredininae. *Tenthredo* sp.
Fig. 14—Cimbicinae. *Abia inflata.*
Fig. 15—Hoplocampinae. *Hemichroa americana.*

au anus
msp mesothoracic spiracle
plg larvapod
spi abdominal spiracle
tlg^2 mesothoracic leg
tsp metathoracic spiracle



YUASA LARVAE OF THE TENTHREDINOIDEA PLATE III

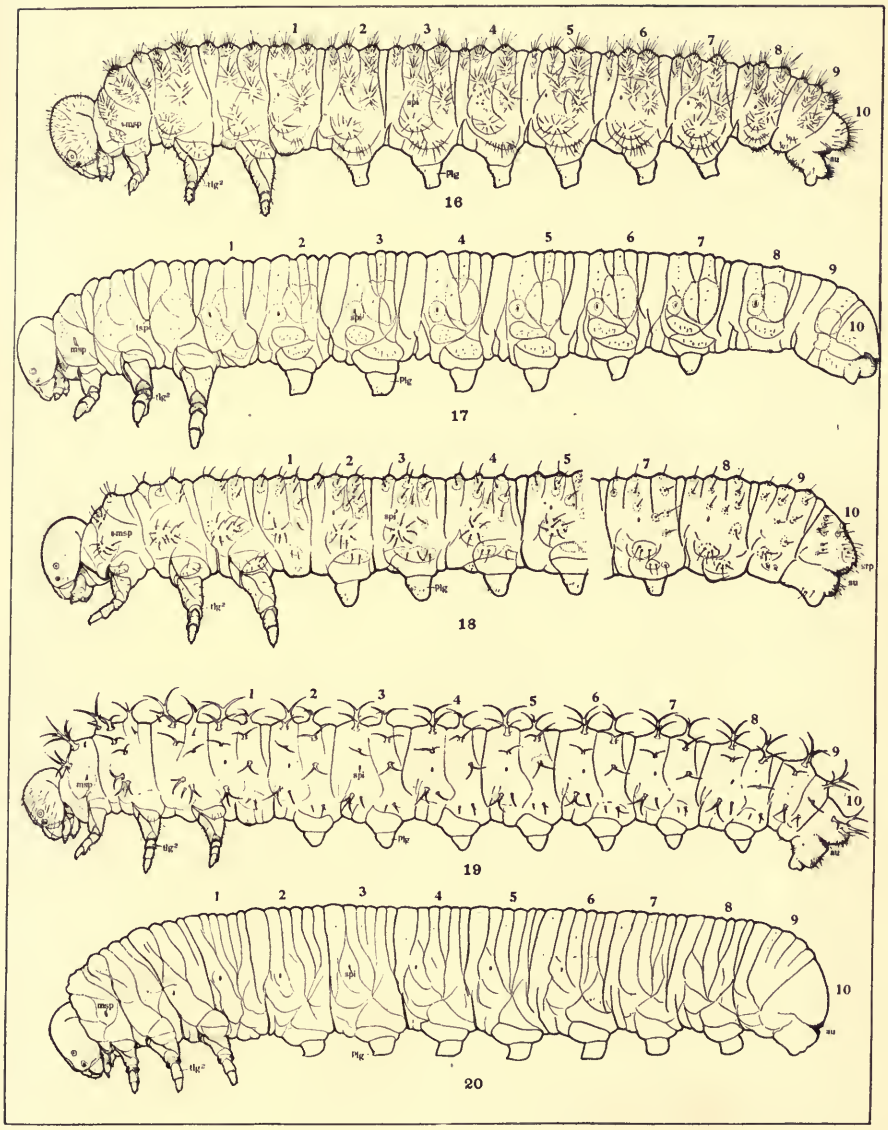
PLATE IV

EXPLANATION OF PLATE

LARVAE OF TENTHREDINIDAE

Fig. 16—Cladiinae. *Cladius pectinicornis.*
Fig. 17—Nematinae. *Pteronidea ventralis.*
Fig. 18—Nematinae. *Pteronidea ribesi.*
Fig. 19—Blennocampinae. *Monophadnoides rubi.*
Fig. 20—Blennocampinae. *Tomostethus bardus.*

au anus
msp mesothoracic spiracle
plg larvapod
spi abdominal spiracle
srp suranal process
tlg^2 mesothoracic leg
tsp metathoracic spiracle



YUASA LARVAE OF THE TENTHREDINOIDEA PLATE IV

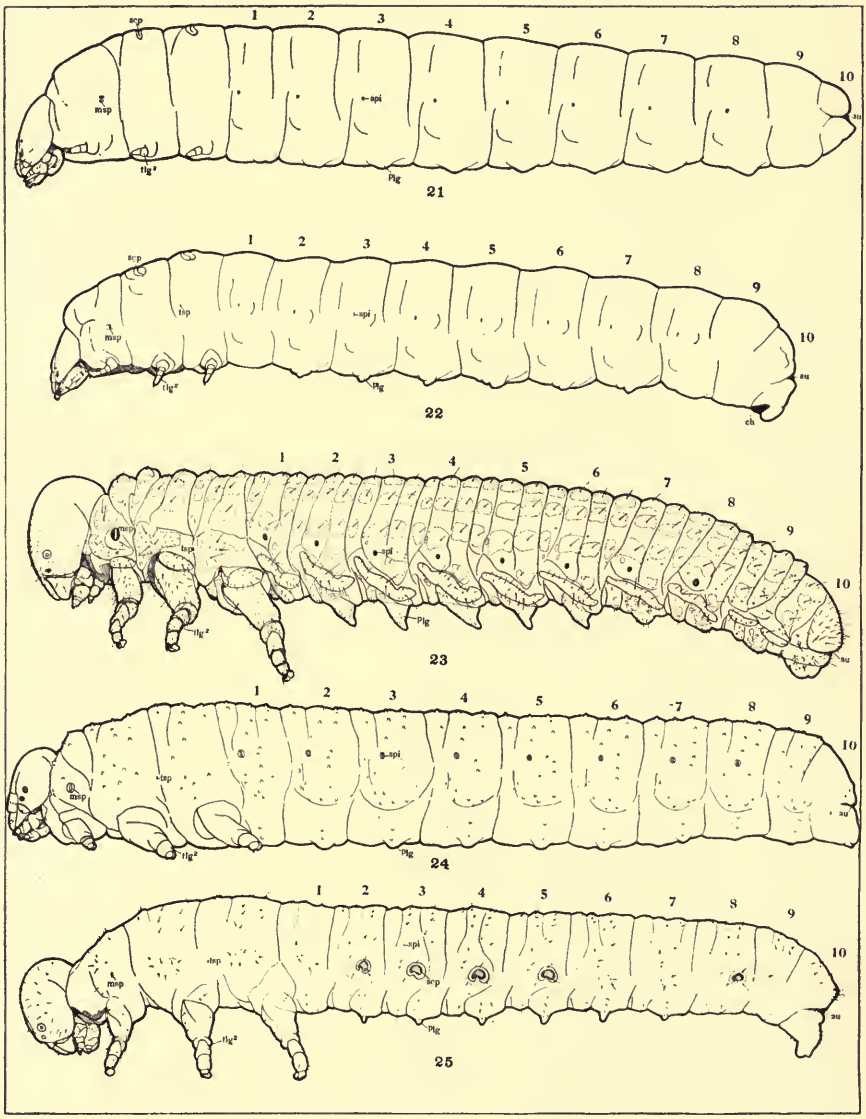
PLATE V

EXPLANATION OF PLATE

LARVAE OF TENTHREDINIDAE

Fig. 21—Fenusinae. *Kaliofenusa ulmi.*
Fig. 22—Scolioneurinae. *Metallus rubi.*
Fig. 23—Hylotominae. *Hylotoma* sp.
Fig. 24—Schizocerinae. *Schizocerus zabriskei.*
Fig. 25—Acordulecerinae. *Acordulecera* sp.

au anus
msp mesothoracic spiracle
plg larvapod
scp sucker-like protuberance
spi abdominal spiracle
tlg[3] mesothoracic leg
tsp metathoracic spiracle



YUASA LARVAE OF THE TENTHREDINOIDEA PLATE V

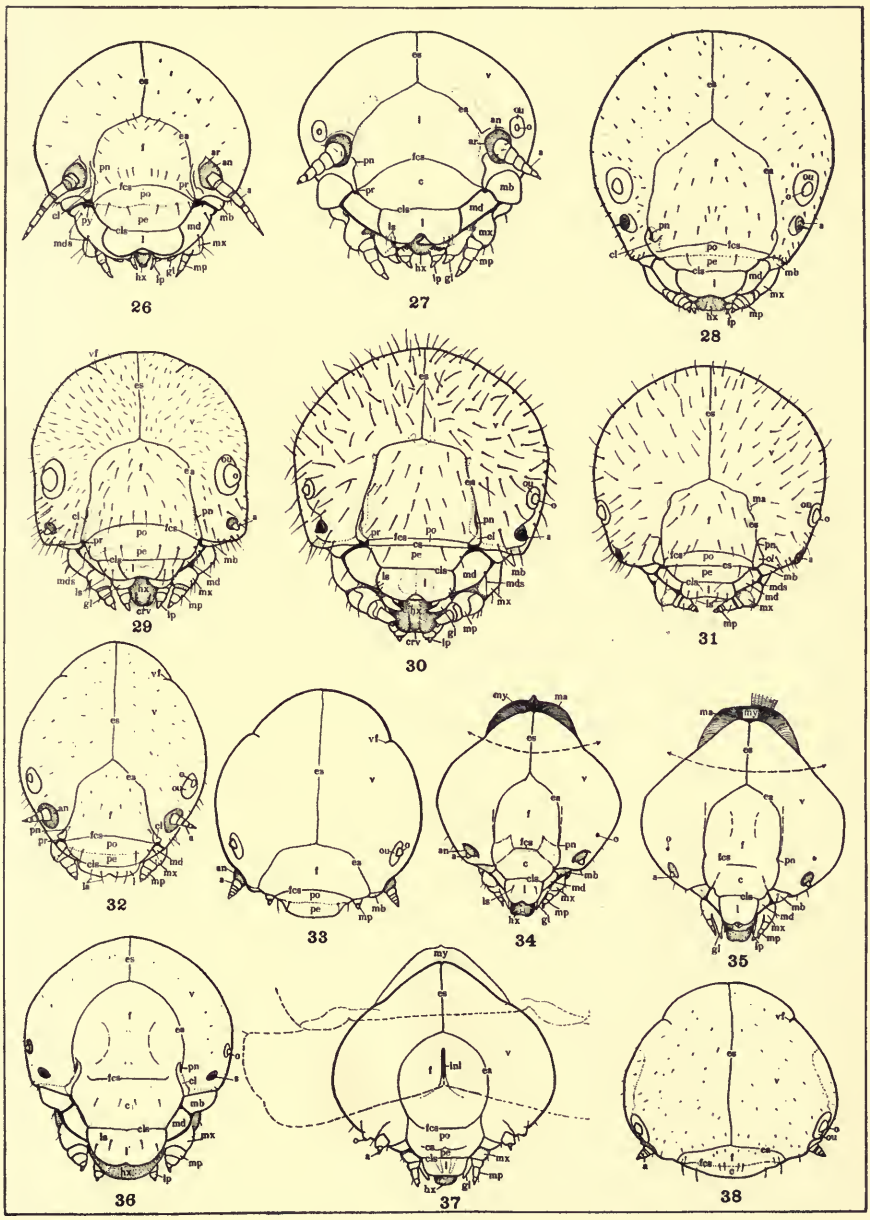
PLATE VI

EXPLANATION OF PLATE

CEPHALIC ASPECT OF THE HEAD

Fig. 26—*Pamphilius* sp.
Fig. 27—*Megaxyela major.*
Fig. 28—*Neodiprion lecontei.*
Fig. 29—*Abia americana.*
Fig. 30—*Pteronidea ribesi.*
Fig. 31—*Lygaeonematus erichsoni.*
Fig. 32—*Endelomyia aethiops.*
Fig. 33—*Macremphytus varianus.*
Fig. 34—*Kaliofenusa ulmi.*
Fig. 35—*Metallus rubi.*
Fig. 36—*Schizocerus zabriskei.*
Fig. 37—*Phlebatrophia mathesoni.*
Fig. 38—*Dolerus similis.*

a antenna
an antacoria
ar antennaria
c clypeus
cl clypealia
cls clypeo-labral suture
crv sericos
cs clypeal suture
ea epicranial arm
es epicranial stem
f front
fcs fronto-clypeal suture
gl galea
hx hypopharynx
inl line of invagination
l labrum
lp labial palpus
ls labral setae
ma muscular attachment
mb mandibularia
md mandible
mds mandibular setae
mp maxillary palpus
mx maxilla
o ocellara
ou ocularia
pe preclypeus
pn pretentorina
po postclypeus
pr precoila
py preartis
v vertex
vf vertical furrow



YUASA LARVAE OF THE TENTHREDINOIDEA PLATE VI

PLATE VII

EXPLANATION OF PLATE

VENTRAL ASPECT OF THE HEAD AND PROTHORAX

Fig. 39—*Pamphilus* sp.
Fig. 40—*Megaxyela major.*
Fig. 41—*Kaliofenusa ulmi.*
Fig. 42—*Dolerus similis.*
Fig. 43—*Neodiprion lecontei.*
Fig. 44—*Macremphytus varianus.*
Fig. 45—*Xiphydria* sp.
Fig. 46—*Tremex columba.*
Fig. 47—*Lygeonematus erichsoni.*
Fig. 48—*Endelomyia aethiops.*
Fig. 49—*Metallus rubi.*

a	antenna
an	antacoria
c	clypeus
cc	cervacoria
cl	clypealia
cls	clypeo-labral suture
crv	sericos
cw	tarsal claw
cx	coxa
ea	epicranial arm
ec	extensacuta
es	epicranial stem
f	front
fcs	fronto-clypeal suture
fm	femur
g	gena
gl	galea
hx	hypopharynx
l	labrum
la	lacinia
lcs	lateral cervical sclerite
li	labium
lp	labial palpus
mb	mandibularia
md	mandible
mp	maxillary palpus
mx	maxilla
o	ocellara
pfn	profurcellina
pn	pretentorina
pr	precoila
py	preartis
t	tibia
tr	trochanter
tg^1	prothoracic leg
v	vertex

YUASA LARVAE OF THE TENTHREDINOIDEA PLATE VII

PLATE VIII

EXPLANATION OF PLATE

VENTRAL AND DORSAL ASPECTS OF HEAD AND PROTHORAX

Fig. 50—*Janus integer.*
Fig. 51—*Schizocerus zabriskei.*
Fig. 52—*Phlebatrophia mathesoni.*
Fig. 53—*Caliroa cerasi.*
Fig. 54—*Pamphilius* sp.
Fig. 55—*Dolerus similis.*
Fig. 56—*Megaxyela major.*
Fig. 57—*Caliroa cerasi.*
Fig. 58—*Neodiprion lecontei.*
Fig. 59—*Endelomyia aethiops.*

a	antenna
c	clypeus
cc	cervacoria
cg	cervical gland
cls	clypeo-labral suture
crv	sericos
cw	tarsal claw
cx	coxa
ea	epicranial arm
ec	extensacuta
es	epicranial stem
f	front
fm	femur
g	gena
gl	galea
hx	hypopharynx
is	intersegmental line (limit of somite)
l	labrum
la	lacinia
lc	labicoria
li	labium
lp	labial palpus
m	mentum
mb	mandibularia
md	mandible
mp	maxillary palpus
msp	mesothoracic spiracle
mx	maxilla
o	ocellara
pfn	profurcellina
pn	pretentorina
t	tibia
tlg[1]	prothoracic leg
ts	tarsus
v	vertex
vf	vertical furrow

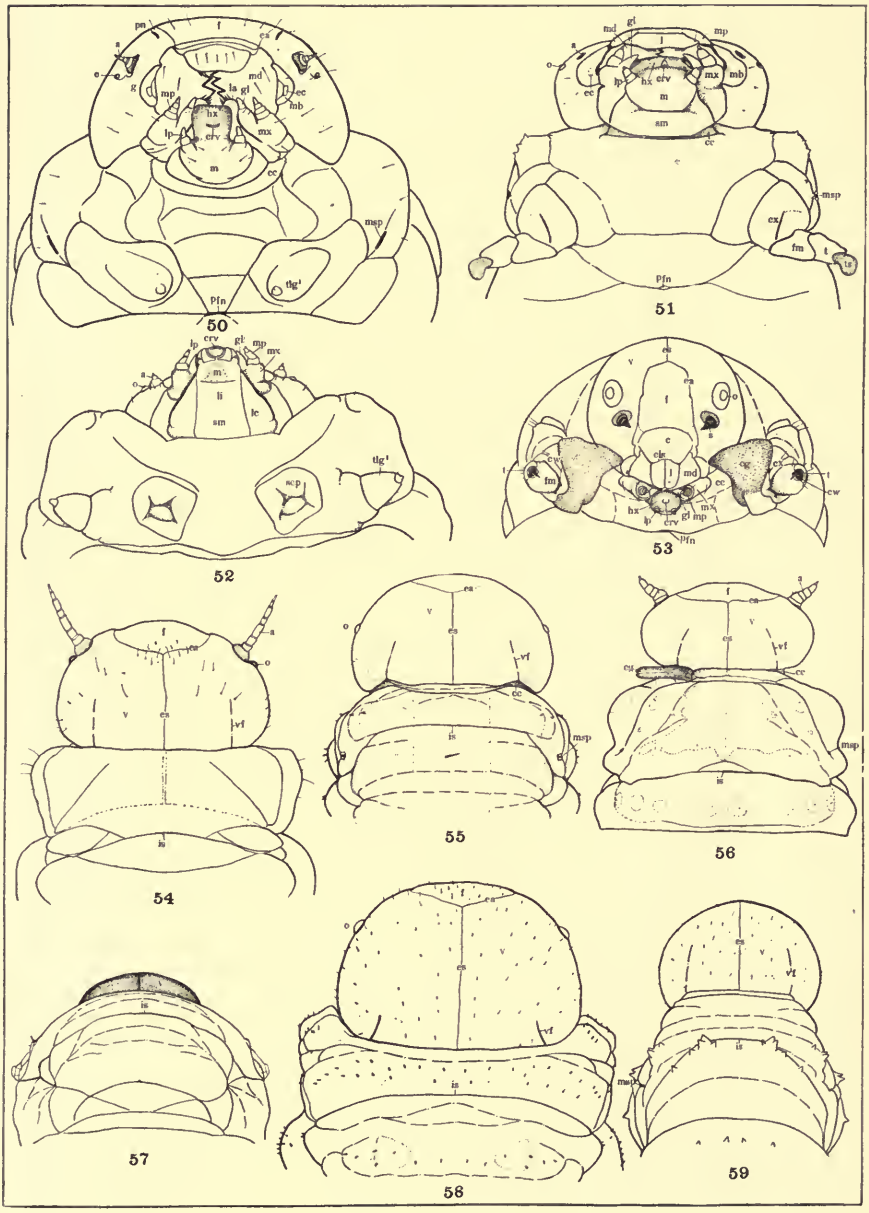

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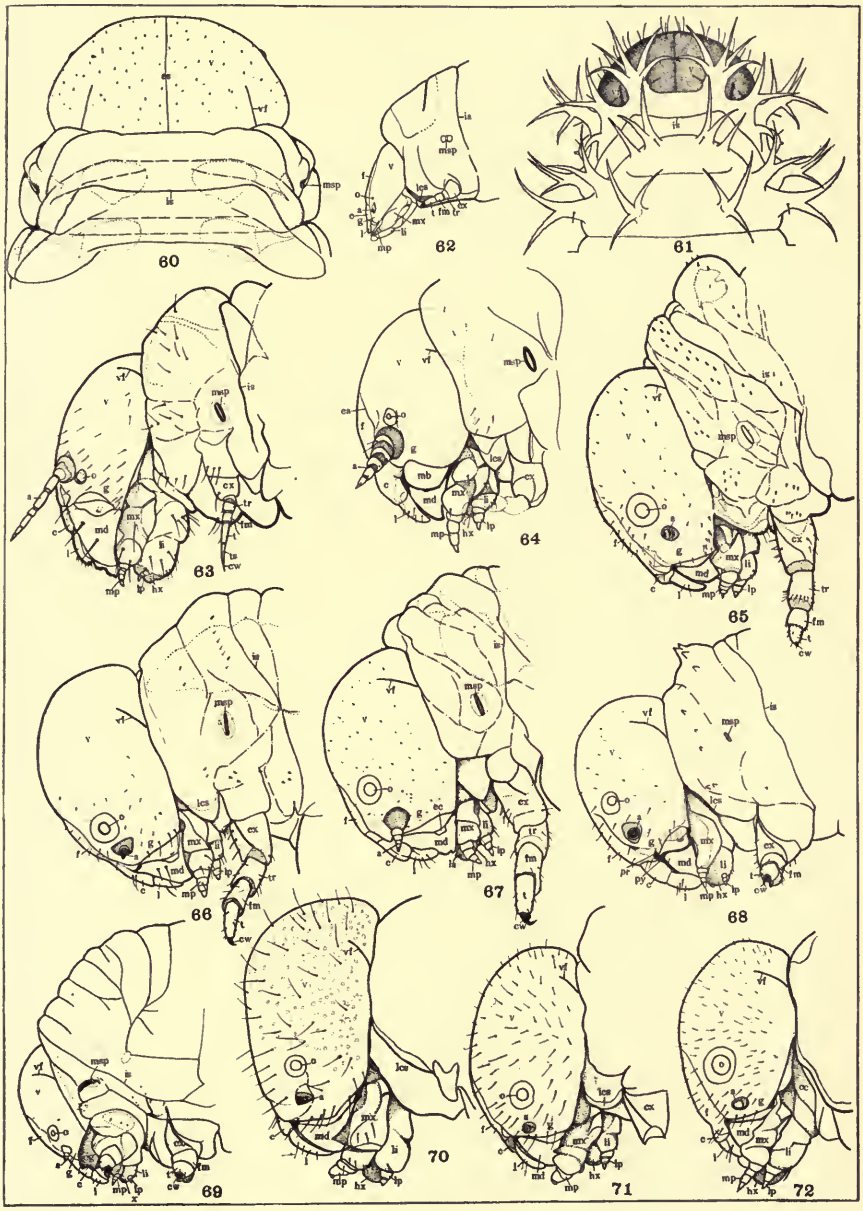
PLATE IX

EXPLANATION OF PLATE

DORSAL AND LATERAL ASPECTS OF HEAD AND PROTHORAX

Fig. 60—*Macremphytus varianus.*
Fig. 61—*Monophadnoides rubi.*
Fig. 62—*Metallus rubi.*
Fig. 63—*Pamphilius* sp.
Fig. 64—*Megaxyela major.*
Fig. 65—*Neodiprion leconlei.*
Fig. 66—*Dolerus similis.*
Fig. 67—*Macremphytus varianus.*
Fig. 68—*Endelomyia aethiops.*
Fig. 69—*Caliroa cerasi.*
Fig. 70—*Pteronidea ribesi.*
Fig. 71—*Lygeonematus erichsoni.*
Fig. 72—*Abia americana.*

a	antenna
c	clypeus
cc	cervacoria
cg	cervical gland
cw	tarsal claw
cx	coxa
ea	epicranial arm
ec	extensacuta
es	epicranial stem
f	front
fm	femur
g	gena
hx	hypopharynx
is	intersegmental line (limit of somite)
l	labrum
la	lacinia
lcs	lateral cervical sclerite
li	labium
lp	labial palpus
mb	mandibularia
md	mandible
mp	maxillary palpus
msp	mesothoracic spiracle
mx	maxilla
o	ocellara
pr	precoila
py	preartis
t	tibia
tr	trochanter
v	vertex
vf	vertical furrow



YUASA LARVAE OF THE TENTHREDINOIDEA PLATE IX

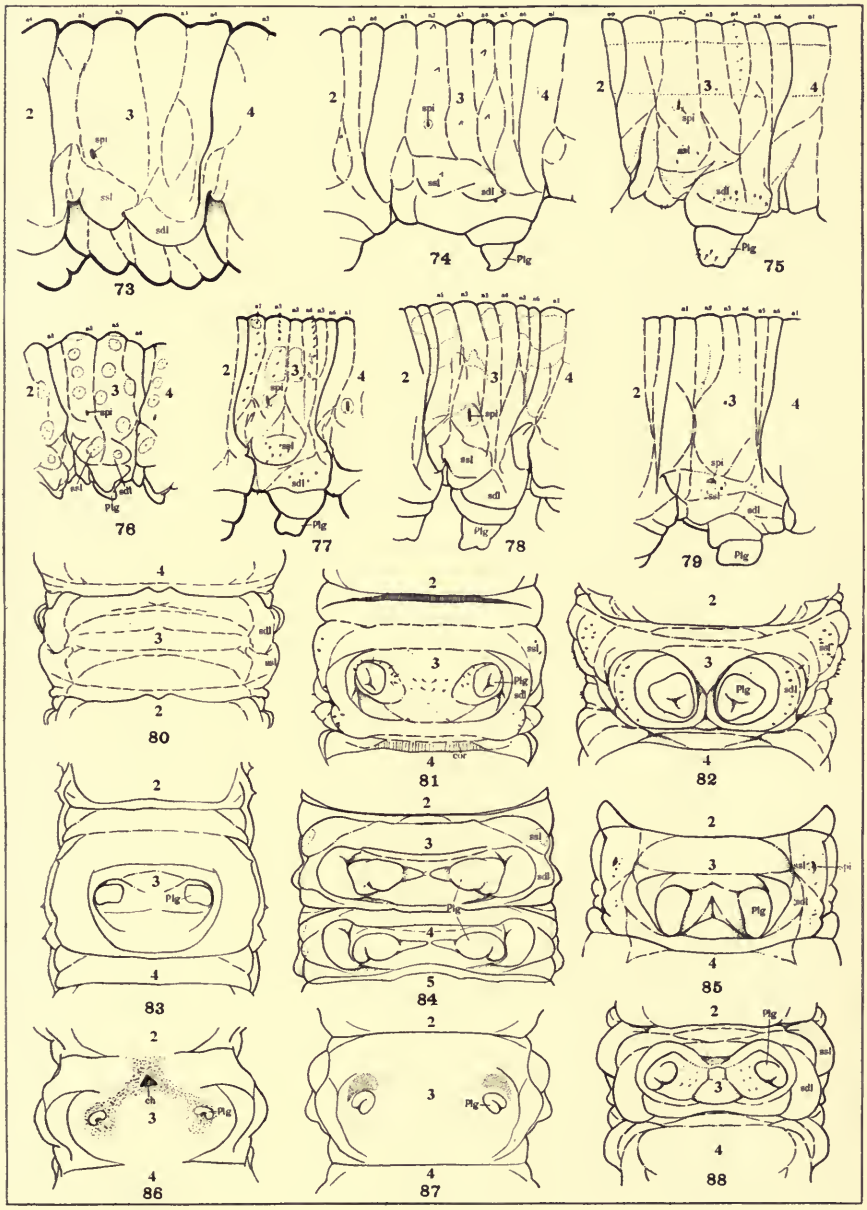
PLATE X

EXPLANATION OF PLATE

LATERAL AND VENTRAL ASPECTS OF THIRD ABDOMINAL SEGMENT

Fig. 73—*Pamphilius* sp.
Fig. 74—*Endelomyia aethiops*.
Fig. 75—*Dolerus similis*.
Fig. 76—*Megaxyela major*.
Fig. 77—*Neodiprion leconlei*.
Fig. 78—*Macremphytus varianus*.
Fig. 79—*Caliroa cerasi*.
Fig. 80—*Pamphilius* sp.
Fig. 81—*Dolerus similis*.
Fig. 82—*Neodiprion leconlei*.
Fig. 83—*Endelomyia aethiops*.
Fig. 84—*Megaxyela major*.
Fig. 85—*Caliroa cerasi*.
Fig. 86—*Kaliofenusa ulmi*.
Fig. 87—*Metallus rubi*.
Fig. 88—*Macremphytus varianus*.

a1-a7 annulets 1, 2, 3, 4, 5, 6, 7.
ch chitinized area.
cor intersegmental coria
plg larvapod
sdl surpedal lobe or area
spi abdominal spiracle
ssl subspiracular lobe or area



YUASA LARVAE OF THE TENTHREDINOIDEA PLATE X

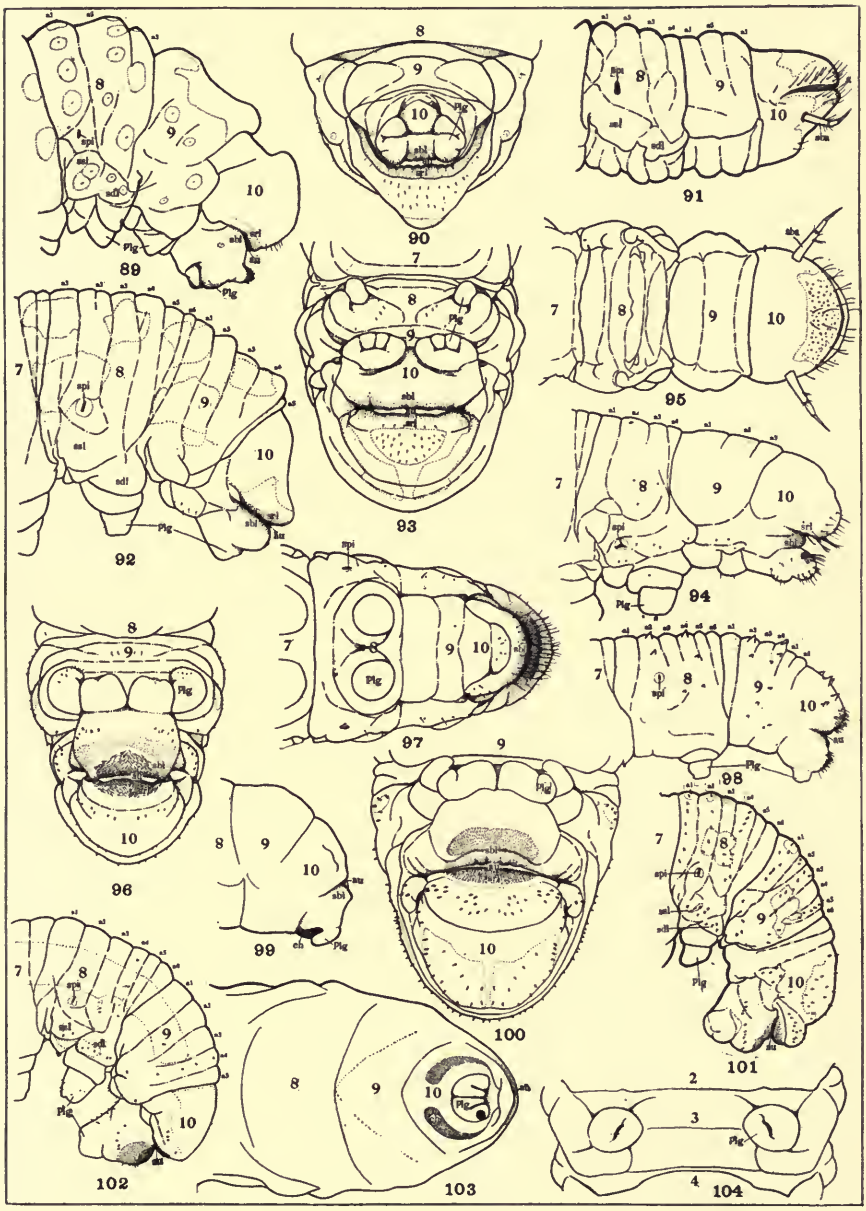
PLATE XI

EXPLANATION OF PLATE

LATERAL AND VENTRAL ASPECTS OF CAUDAL ABDOMINAL SEGMENTS

Fig. 89—*Megaxyela major.*
Fig. 90—*Megaxyela major.*
Fig. 91—*Pamphilius* sp.
Fig. 92—*Macremphytus varianus.*
Fig. 93—*Macremphytus varianus.*
Fig. 94—*Caliroa cerasi.*
Fig. 95—*Pamphilius* sp.
Fig. 96—*Dolerus similis.*
Fig. 97—*Caliroa cerasi.*
Fig. 98—*Endelomyia aethiops.*
Fig. 99—*Metallus rubi.*
Fig. 100—*Neodiprion lecontei.*
Fig. 101—*Neodiprion lecontei.*
Fig. 102—*Dolerus similis.*
Fig. 103—*Metallus rubi.*
Fig. 104—*Phlebatrophia mathesoni.* Ventral aspect of third abdominal segment.

au	anus
a1	annulet 1
a2	annulet 2
a6	annulet 6
ch	chitinized area
plg	larvapod
sba	subanal appendage
sbl	subanal lobe
sdl	surpedal lobe or area
spi	abdominal spiracle
srl	suranal lobe
ssl	subspiracular lobe or area



YUASA LARVAE OF THE TENTHREDINOIDEA PLATE XI

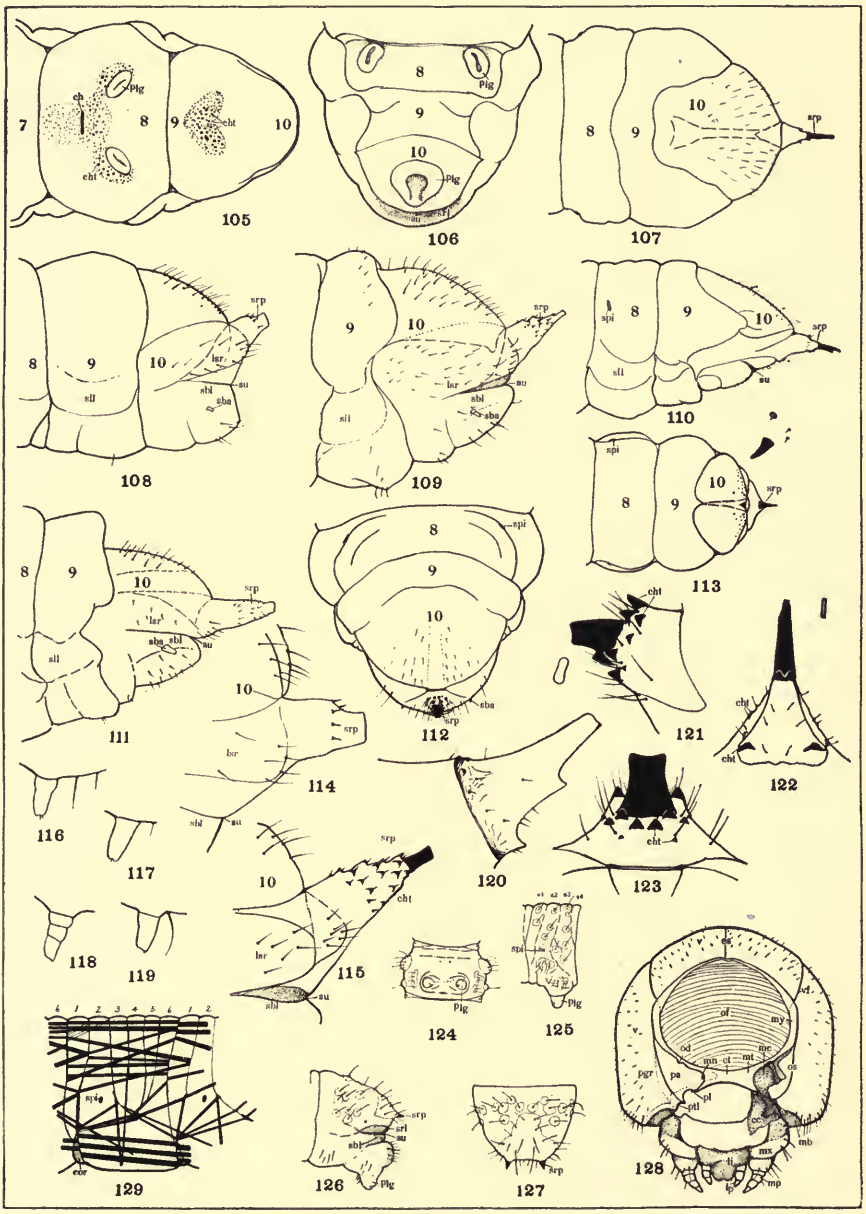
PLATE XII

EXPLANATION OF PLATE

CAUDAL ASPECT OF HEAD, ABDOMEN, ABDOMINAL APPENDAGES

Fig. 105—*Kaliofenusa ulmi.* Ventral aspect of caudal abdominal segment.
Fig. 106—*Phlebatrophia mathesoni.*
Fig. 107—*Xiphydria* sp.
Fig. 108—*Cephus pygmaeus.*
Fig. 109—*Adirus trimaculatus.*
Fig. 110—*Xiphydria* sp.
Fig. 111—*Hartigia cressoni.*
Fig. 112—*Janus integer.*
Fig. 113—*Tremex columba.*
Fig. 114—*Cephus pygmaeus.* Caudal end of the abdomen enlarged.
Fig. 115—*Adirus trimaculatus.*
Fig. 116—*Adirus trimaculatus.* Subanal appendage enlarged.
Fig. 117—*Hartigia cressoni.* Subanal appendage enlarged.
Fig. 118—*Janus* sp. Subanal appendage enlarged.
Fig. 119—*Cephus pygmaeus.* Subanal appendage enlarged.
Fig. 120—*Tremex columba.* Lateral aspect of suranal process enlarged.
Fig. 121—*Janus integer.* Lateral aspect of suranal process enlarged.
Fig. 122—*Tremex columba.* Dorsal aspect of suranal process enlarged.
Fig. 123—*Janus integer.* Dorsal aspect of suranal process enlarged.
Fig. 124—*Pteronidea ribesi.* Ventral aspect of third abdominal segment.
Fig. 125—*Pteronidea ribesi* Lateral aspect of caudal end of abdomen.
Fig. 126—*Pteronidea ribesi.* Lateral aspect of caudal end of abdomen.
Fig. 127—*Pteronidea ribesi.* Dorsal aspect of caudal end of abdomen.
Fig. 128—*Abia americana.* Caudal aspect of the head.
Fig. 129—*Neodiprion lecontei.* Musculature of third abdominal segment. semidiagrammatic. Annulets numbered.

au anus
cc cervacoria
ch chitinized area
cht chitinized tubercle
cor coria
ct corpotentorium
es epicranial stem
li labium
lp labial palpus
lsr lateral area of suranal lobe
mb mandicoria
mc maxacoria
mn metatentorina
mp maxillary palpus
mt metatentorium
mx maxilla
my maxillaria
od odontoidea
of occipital foramen
os occipital suture
pa postgena
pgr postgenal ridge
pl paracoila
plg larvapod
ptl postcoila
pa postgena
sba subanal appendage
sbl subanal lobe
sll sublateral lobe
spi abdominal spiracle
srp suranal process



YUASA LARVAE OF THE TENTHREDINOIDEA PLATE XII

PLATE XIII

EXPLANATION OF PLATE

ANTENNAE, LEGS, SILK-GLANDS

Fig. 130—*Pamphilius* sp. Metathoracic leg.
Fig. 131—*Megaxyela major*. Metathoracic leg.
Fig. 132—*Macremphytus varianus*. Metathoracic leg.
Fig. 133—*Pteronidea ribesi*. Mesothoracic leg.
Fig. 134—*Neodiprion lecontei*. Metathoracic leg.
Fig. 135—*Dolerus similis*. Metathoracic leg.
Fig. 136—*Phlebatrophia mathesoni*. Metathoracic leg.
Fig. 137—*Metallus rubi*. Metathoracic leg.
Fig. 138—*Pteronidea ribesi*. Mesothoracic leg. Dorsal aspect.
Fig. 139—*Schizocerus zabriskei*. Metathoracic leg.
Fig. 140—*Kaliofenusa ulmi*. Metathoracic leg.
Fig. 141—*Caliroa cerasi*. Metathoracic leg.
Fig. 142—*Endelomyia aethiops*. Metathoracic leg.
Fig. 143—*Megaxyela major*. Antena.
Fig. 144—*Adirus trimaculatus*. Antenna.
Fig. 145—*Schizocerus zabriskei*. Antenna.
Fig. 146—*Cephus pygmaeus*. Antenna.
Fig. 147—*Metallus rubi*. Antenna.
Fig. 148—*Tremex columba*. Antenna.
Fig. 149—*Kaliofenusa ulmi*. Antenna.
Fig. 150—*Phlebatrophia mathesoni*. Antenna.
Fig. 151—*Janus integer*. Antenna.
Fig. 152—*Hartigia cressoni*. Antenna.
Fig. 153—*Thrinax impressatus*. Antenna.
Fig. 154—*Pteronidea ribesi*. Antenna.
Fig. 155—*Tremex columba*. Mesothoracic spiracle.
Fig. 156—*Abia americana*. Silk-glands.
Fig. 157—*Abia americana*. Labium, hypopharynx, and portion of silk-glands, enlarged.
Fig. 158—*Abia americana*. Lateral aspect of cephalic portion of silk-glands.
Fig. 159—*Abia americana*. Dorsal view of silk-press, hypopharynx removed.
Fig. 160—*Abia americana*. Cephalic view of labium and hypopharynx.

a1-a6 antennal segments 1, 2, 3, 4, 5, and 6
an antacoria
cr cericos
cw tarsal claw
cx coxa
D arrow pointing dorsad
fm femur
fp femoral process
hx hypopharynx
li labium
lp labial palpus
M arrow pointing mesad
sd duct of silk-glands
sgc cells of silk-gland
sgd small duct of silk-glands
slpr silk-press

YUASA LARVAE OF THE TENTHREDINOIDEA PLATE XIII

PLATE XIV

EXPLANATION OF PLATE

Chart representing graphically the relationship of various taxonomic units or groups according to the more important modern systems of classification of the Tenthredinoidea as proposed by Konow (1905), MacGillivray (1906), and Rohwer (1911-1918).

YUASA LARVAE OF THE TENTHREDINOIDEA PLATE XIV

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